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RESEARCH LABORATORY

TECHNICAL REPORT

CHEMICAL CORROSION OF ROCKET LINER
MATERIALS AND PROPELLANT
PERFORMANCE STUDIES (U)
DETAILED THEORETICAL PERFORMANCE OF
SOME LIQUID PROPELLANT SYSTEMS

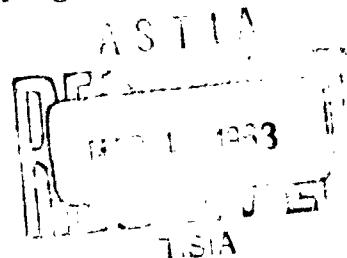
Second Quarterly Technical Summary Report
Volume Two of Three

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20 January 1963



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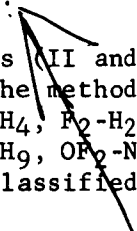
SECTION 1

SUMMARY.



The theoretical performance of certain binary liquid propellant systems under a wide variety of expansion conditions and mixture ratios has been computed and results are presented in graphical and tabular form. The graphs show vacuum specific impulse for area ratios of 8, 20, and 50, sea level optimum specific impulse, characteristic velocity, molecular weight and chamber temperature as a function of mixture ratio, for both frozen and equilibrium (shifting) expansion conditions, at chamber pressures of 300 and 1000 psi. The tabular data are in the form of computer output sheets, and give detailed performance and other data for all integral area ratios from 1 to 50; values are also given at two larger area ratios, the values depending on the system. Altitude effects are discussed, and techniques described for computing ideal performance for any of these mixtures at any altitude; results are given for sea level, 10,000 feet and 50,000 feet and vacuum as a function of area ratio for each mixture for zero divergence angle. The methods used in carrying out the computations are described briefly, with reference to more detailed descriptions. The latest thermodynamic data are used, and a large number of minor species are considered for maximum precision.

This portion of the work is reported in two volumes (II and III) of this Second Quarterly Report. Volume II describes the methods used and gives results for eleven propellant systems ($\text{ClF}_3\text{-N}_2\text{H}_4$, $\text{F}_2\text{-H}_2$, $\text{H}_2\text{O}_2\text{-B}_5\text{H}_9$, $\text{N}_2\text{F}_4\text{-B}_5\text{H}_9$, $\text{N}_2\text{H}_4\text{-B}_5\text{H}_9$, $\text{N}_2\text{O}_4\text{-N}_2\text{H}_4$, $\text{OF}_2\text{-B}_2\text{H}_6$, $\text{OF}_2\text{-B}_5\text{H}_9$, $\text{OF}_2\text{-N}_2\text{H}_4$, $\text{O}_2\text{-H}_2$, and $\text{O}_2\text{-RP-1}$); Volume III gives results for certain classified systems.

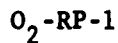
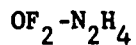
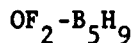
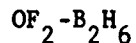
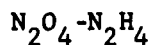
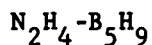
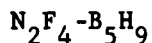
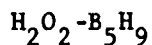
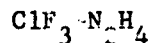


SECTION 2

INTRODUCTION

Theoretical performance calculations, even though idealized, are useful in making preliminary comparisons of different propellant systems. Quite obviously, such comparisons should be made under the conditions of a specific application rather than at some arbitrary standard condition such as optimum expansion at sea level. It is our purpose here to provide the theoretical data needed for these more detailed comparisons for certain specified liquid propellant systems of interest, using the latest available thermodynamic data.

This volume contains results for the following systems:



SECTION 3

CALCULATION METHODS

3.1 COMPUTATION OF PERFORMANCE

a. Performance at Specific Pressures - the Pressure Profile

The performance calculation method is based on an extension of the free energy minimization procedure originally suggested by White, Johnson, and Dantzig¹ and has been described in a number of publications^{2,3,4}. The standard assumptions are made, which include adiabatic combustion of the reactants, isentropic expansion, perfect gas behavior, zero nozzle divergence angle, and zero linear velocity in the chamber. Performance is computed both for frozen expansion, in which no change in chemical composition is permitted for propellants leaving the chamber--although liquid-solid transformations are permitted, and for the case where complete chemical and phase equilibrium is required at every point in the system. Results are generally reported here for chamber pressures of 300 and 1000 psia. For other pressures, or for predicting the variation in performance to be expected by changes in the data used in the calculations, the discussions by Wilkins and Weiher⁵ and by Gordon and Zeleznik⁶ should be consulted.

The program as used is set up to compute necessary parameters at 10 exponentially spaced pressures (plus the throat and at 14.696 psia) between the chamber pressure and an exhaust pressure which is set to be sufficiently low that two of the points are at a nozzle area ratio greater than the final value desired; this permits interpolation with a four-point logarithmic routine to give values at all integral area ratios between 1 and 50 as desired. Complete composition, temperature, and performance data are computed and reported at each of the profile points. The pressure profile

points are spaced according to the relation

$$P_n = \frac{P_c}{\left(\frac{P_c}{P_e}\right)^{n/N}} \quad (1)$$

where P_n = exhaust stream static pressure at nth pressure profile point,

P_c = chamber pressure

P_e = final exhaust pressure

n = profile number

N = total number of profiles specified

Impulse values are calculated at each profile point for both optimum expansion (assuming the surroundings are at the static pressure of the point in question) and at vacuum conditions. The equations used are

$$I_{OPT} = 29.49534 \sqrt{H_c - H_e} \quad (2)$$

$$I_{VAC} = I_{OPT} + 0.86452 \frac{\bar{X}_e T_e}{I_{OPT}} \quad (3)$$

where

I_{OPT} = optimum expansion specific impulse

I_{VAC} = vacuum specific impulse

H_c = chamber enthalpy, kcal/100 grams

H_e = exhaust enthalpy, kcal/100 grams

\bar{X}_e = moles gas/100 grams at exhaust plane

T_e = exhaust temperature, °K

In order to find the throat and to compute the area ratio, the mass flow rate is first determined at each profile point, according to

$$\rho_u = 2397.9 \frac{P_c}{X_e T_e} \sqrt{H_c - H_e} \quad (4)$$

where ρ_u is in gm/cm²-sec, and P_c is in psia. (This value is not printed out on the output sheet but the necessary data are given at each profile point.) The throat is found by locating the pressure in the system at which ρ_u is a maximum; the nozzle area ratio at any point is then

$$\epsilon = \frac{(\rho_u)_t}{(\rho_u)_e} \quad (5)$$

where

$(\rho_u)_t$ = flow rate in the throat

$(\rho_u)_e$ = flow rate at profile point in question

The characteristic velocity is calculated from

$$C^* = \frac{2262.03}{(\rho_u)_t} P_c \quad (6)$$

where

C^* = characteristic velocity, ft/sec

P_c = chamber pressure, psia.

Note that once $(\rho_u)_t$ is known, ρ_u at any area ratio can be found directly from equation (6), rather than from equation (5). The thrust coefficient C_F (dimensionless) is simply

$$C_F = 32.174 \frac{I_{sp}}{C^*} \quad (7)$$

where I_{sp} represents the specific impulse, vacuum, altitude, or sea level, where the thrust coefficient is desired.

Densities of the various liquids at the feed temperature are included in the input description. The bulk density is defined as

$$\rho_{\text{Bulk}} = \frac{100}{\frac{X_A}{\rho_A} + \frac{X_B}{\rho_B}} \quad (8)$$

where X_A and X_B represent the weight percentages of components A and B. This value can be used in burnout velocity comparisons or in comparisons involving the product of density and specific impulse.

The specific heat at constant pressure (C_p) requires extra comment, as completely adequate means for finding its value as a function of area ratio appear too expensive to be merited. The approach has been to compute C_p for both shifting and frozen conditions by the formula

$$C_p = \left(\frac{\partial H}{\partial T} \right)_p \approx \left(\frac{H_{T+\Delta T} - H_{T-\Delta T}}{2\Delta T} \right)_p \quad (9)$$

Where C_p is in cal/gm-°K, H is in kcal/100 grams, and ΔT is set at 5°, the equation reduces to

$$C_p \approx \frac{H_{(T+\Delta T)} - H_{(T-\Delta T)}}{2\Delta T} \quad (9a)$$

The ΔT of 5° was set after trials with several larger and smaller increments; this value appeared to give the best general accuracy. The problem with this approach is where phase changes occur within the interval, either by appearance or disappearance of a condensed phase (in shifting expansion) or by freezing, which in our program can occur either with frozen or shifting expansion. (C_p , in fact, becomes infinite at a freezing point.) Further difficulties are then encountered if interpolation is attempted using a four-point interpolation routine, as very high values at one profile point followed by a reasonable value at the next often are interpolated to give negative values in between. A variety of techniques have been suggested to handle the problems, generally involving rather complicated rests or considerable machine time. The approach which has been taken is, however, the very simple one of requiring that all four points in the interpolation region decrease in specific heat with increasing area ratio; if not, condensation, freezing, or other unusual effects are assumed to be involved, and no value is printed out. It is, of course, possible that specific heat values are normal at each point in the interval, but that a freezing point is involved in the middle of one of the intervals. Errors of this nature will not be rejected by the test procedure.

No γ values have been reported, due to the somewhat ambiguous nature of this term, especially in the case of equilibrium expansion. The tabulated data can, however, be used to give a value based on the particular definition assigned. If γ is defined as follows

$$\gamma = \left(\frac{\partial \ln P}{\partial \ln \rho_s} \right) \quad (10)$$

a value can be derived from a plot of $\ln P$ vs. $\ln \rho$ either over an interval, or by slope measurement, at a point. The value of ρ in gm/cm³ can be obtained at any point from

$$\rho = \frac{2.3066 P_c}{C^* \epsilon I_{OPT}} \quad (11)$$

where the symbols have their previous meanings. Alternatively for frozen expansion, γ can be obtained from the C_p value and the molecular weight

$$\gamma_{fr} = \frac{C_{pfr}}{C_{pfr} - \frac{R}{M}} \quad (12)$$

where R is the universal gas constant 1.986 cal/mole-°K, and M is $\frac{100}{\bar{X}}$, where \bar{X} is the number of moles of gas per 100 grams.

It should be noted that in equilibrium expansion a value of γ relating pressure and density over an interval (which for a differential interval is defined by equation 10), will be different numerically from γ relating pressure and temperature, according to

$$\gamma = \frac{1}{1 - \left(\frac{\partial \ln T}{\partial \ln P} \right)_s} \quad (13)$$

as for these two values of γ to be equal (equations 10 and 13), the molecular weight must be constant*

b. Performance at Specified Area Ratios and Altitudes

The data computed at each profile point are used to compute data at the 50 integral area ratios desired by four-point logarithmic interpolation. The resulting data are given for both frozen and shifting expansion.

*A number of mean γ values can also be computed, based on the calculated specific impulse or other performance parameters.

On the interpolation output sheets, the difference between I_{VAC} and I_{OPT} is termed DELVAC, representing the increment between the vacuum and optimum expansion value; it, along with DELVAC divided by the exhaust pressure (DELVAC/P), is used in computing impulse at specified altitude as follows

$$I_{ALT} = \lambda I_{OPT} + DELVAC \left(1 - \frac{P_o}{P_e} \right) \quad (14a)$$

$$\text{or } I_{ALT} = I_{VAC} - \left(\frac{DELVAC}{P} \right) P^o - I_{OPT} (1 - \lambda) \quad (14b)$$

where λ represents the divergence angle correction and where P^o represents the ambient pressure, in psia. This equation is normally used in cases where P^o is less than or equal to P ; where P^o exceeds P (over expansion) a decrease in performance below the optimum expansion value is indicated, but the magnitude of this decrease can be greatly overestimated by this equation, especially at high area ratios, inasmuch as such nozzles do not always in fact, run "full". The overexpanded case has thus been excluded from consideration here.

The value of λ depends on the particular nozzle; for an ideal nozzle with zero divergence angle, it is equal to unity so that the final term in equation (14b) drops out. The assumption of zero divergence was used here to calculate performance at sea level, 10,000 and 50,000 feet, as well as at vacuum for each case. Altitude effects are amplified in Section 3.3 below.

3.2 THERMODYNAMIC DATA*

Thermodynamic data employed in these calculations are the latest values reported in the JANAF tables. One species, C_2H , has been added, based on the work of Hildenbrand⁷; this species is not important in these runs. The data as used begin at 298°K so that the very few points reported on the computer output sheets at extreme expansion ratios which are calculated to have temperatures lower than 298°K must be considered suspect. In general, a large number of normally relatively unimportant species have been included in these computations in order to obtain the maximum precision at all stoichiometries. The summary sheets show compositions (moles/100 grams) to four decimal places. The computer program, however, does not reject a species as being zero until its mole number is less than 10^{-6} .

*Propellant heats of formation are discussed in Vol. III of this report.

The heat of formation used for BOF(g) was -143.00 kcal/mole. This value is in close agreement with the value of -144.00 recently reported by Hildenbrand⁸. Note that the heat of formation value used for each species is given in the printout; this usually is the most important single thermodynamic datum, and yet is often the most unreliable. Values used for propellant heats of formation are also shown on the printout. The printing out of these values will aid in interpretation of these results in the future, should new heat of formation data become available.

3.3 ALTITUDE EFFECTS

The conventional comparison of propellants on an impulse basis at sea level optimum expansion is convenient, but, as noted earlier, not necessarily definitive. A somewhat better approach might involve a "trajectory-averaged impulse" at a given area ratio, but the computation of such a value would be expensive to obtain and limited in significance to a particular mission. An easier approach, which we have selected, is to compute performance at specified area ratios at three arbitrary altitudes and vacuum, which correspond roughly to the conditions encountered by a first-stage booster where 0, 25, 50, and 100 percent of the fuel is burned.

In order to select the altitudes for specific impulse calculations, an equation was derived for the altitude of a first-stage booster as a function of fraction of fuel consumed, assuming no drag, neglecting impulse variations with altitude, and assuming a straight line trajectory and a flat earth. The equation is as follows:

$$h = \frac{I_{sp}^2 g_c \cos \theta}{T} \left\{ \left(1 - \frac{T_{t_{bo}} P_F}{I_{sp}} \right) \left[\ln \left(1 - \frac{T_{t_{bo}} P_F}{I_{sp}} \right) - 1 \right] + 1 \right\} - g_{t_{bo}}^2 \frac{P_F^2}{2}$$

where h = altitude, feet

I_{sp} = specific impulse, sec

g_c = conversion constant, 32.174 lb.mass-ft/lb.force-sec²

θ = firing angle from vertical

T = initial thrust/gross weight ratio

t_{bo} = total burning time, sec

P_F = percentage fuel consumed

g = local acceleration of gravity, assumed constant at 32.174 ft/sec²

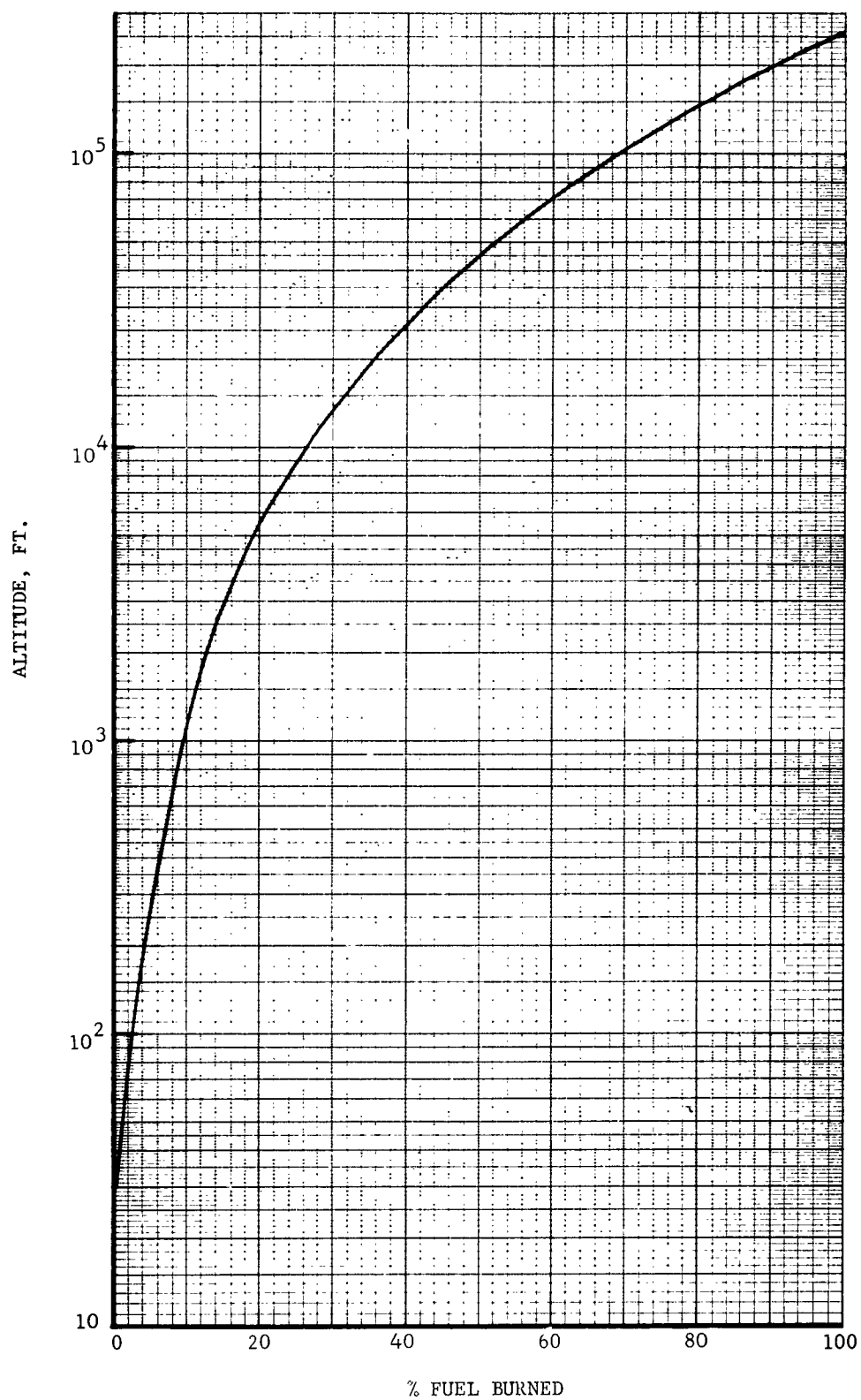
This equation gives the following results for a case where $t_{bo} = 150$ sec, $T = 1.5$, $I_{sp} = 300$ sec, ($m_{bo}/M_{Initial} = 0.25$), for vertical and 30° off-vertical firings:

$\theta = 0^\circ$			$\theta = 30^\circ$		
P_F	h_{ft}	h/h_{bo}	P_F	h_{ft}	h/h_{bo}
0.25	1.4×10^4	.03	0.25	9.1×10^3	.03
0.50	6.7×10^4	.16	0.50	4.6×10^4	.15
0.75	2.0×10^5	.51	0.75	1.5×10^5	.48
1.0	4.1×10^5	1.00	1.0	3.1×10^5	1.00

Note that 25 percent of the fuel is burned in achieving 3 percent of burnout altitude, and 50 percent of the fuel is consumed in reaching 15-16 percent of burnout altitude. Note also, that about 25 percent of the fuel is burned by the time 10,000 feet is reached, and about 50 percent by the time 50,000 feet is reached.

In order to check the validity of these results, an accurate computation, obtained by numerical integration on a computer for a typical first-stage trajectory, and including all the factors neglected in the simplified analysis was obtained for comparison, with results plotted in Figure 1. In this real case, 25 percent of the fuel is consumed at the 10,000 ft. mark and 52 percent at the 50,000 ft. mark.

Based on these considerations, computations of theoretical impulse were made at the 10,000 and 50,000 foot levels, as well as at sea level and at vacuum conditions. Pressures at these levels were taken by interpolation of the data provided by COSPAR⁹, as being 10.2695 psia at 10,000 feet and 1.7058 psia at 50,000 feet. A plot of the pressure as a function of altitude to 105,000 feet, using COSPAR data is shown in Figure 2.



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FIGURE 1. PERCENTAGE FUEL CONSUMED VS ALTITUDE REACHED -
TYPICAL FIRST STAGE TRAJECTORY

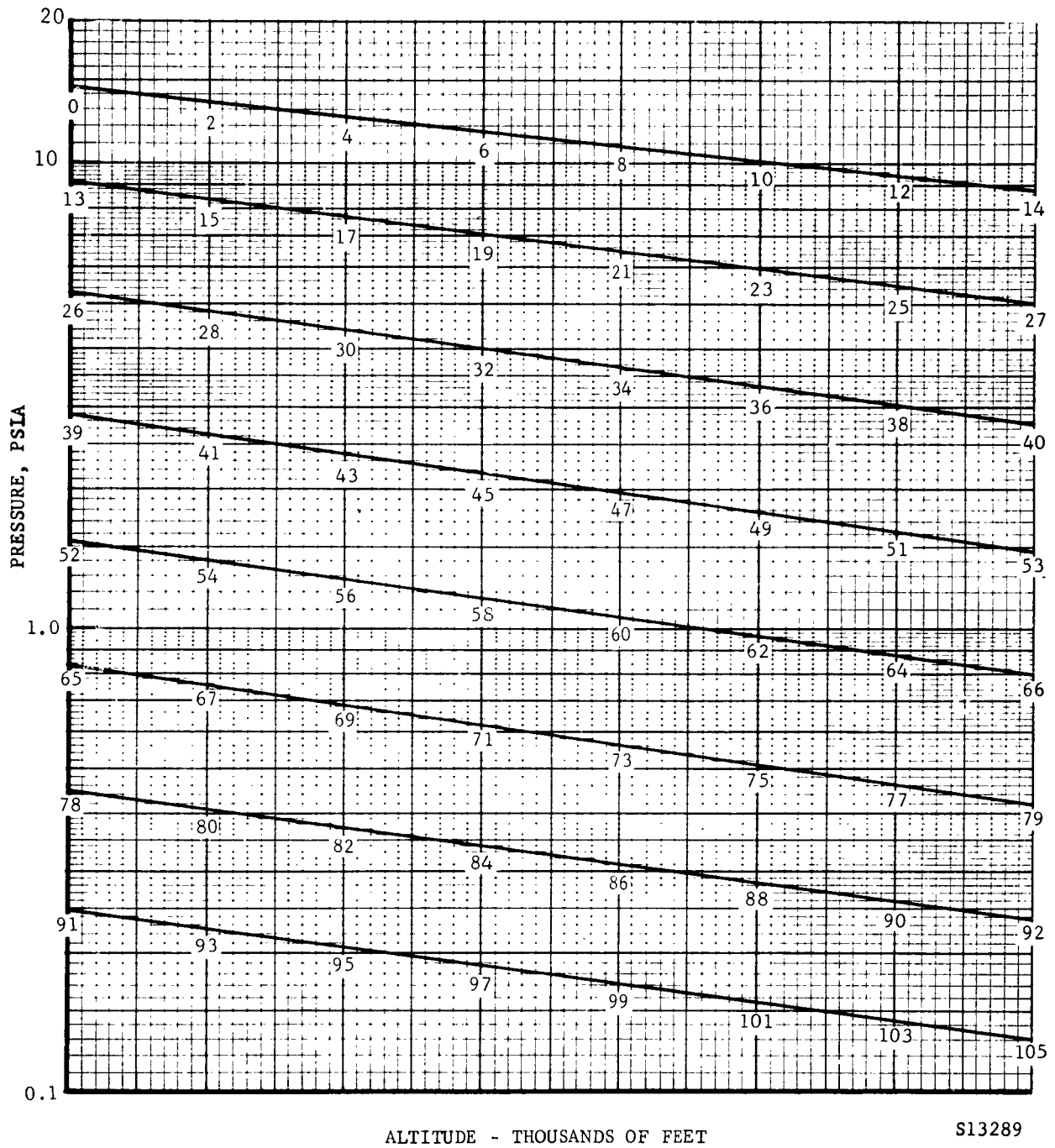


FIGURE 2. COSPAR INTERNATIONAL REFERENCE ATMOSPHERE 1961

SECTION 4

RESULTS AND DISCUSSION

Results are presented in the form of summary graphs (Figures 3-13), which are included in this Section, and computer output sheets, which are given in Section 5. In addition, a tabulation of maximum impulse values and other data for the various systems at various conditions is given as Table I immediately following. The systems can thus be studied in increasing detail by considering first Table I, then the appropriate graphs, and finally the computer output sheets. Altitude performance data must be obtained from the computer output sheets themselves. The systems studied are arbitrarily arranged alphabetically by oxidizer. N_2H_4 is arbitrarily considered the oxidizer in the N_2H_4 - B_5H_9 system.

Our primary purpose here is to present the data for the various systems, and not to attempt comparisons, as such comparisons are valid only for specific applications. However, a few comments appear to be worth mentioning, as follows:

(1) Some deviation is to be expected from previously published results due to use of up-to-date thermodynamic data. This is evident for example, in the H_2O_2 - B_5H_9 system, in that results herein differ in some regions by three or four seconds from results published previously by this laboratory¹⁰. (Maximum sea level optimum shifting impulse appears to be a few seconds lower using the more modern data; in certain non-optimum composition regions the old values were in some cases higher.)

(2) As would be expected, the hotter systems show greater losses in impulse if freezing of chemical reactions takes place than do cooler systems. Thus, the ClF_3 - N_2H_4 system shows nearly identical impulse values to the N_2O_4 - N_2H_4 system with equilibrium expansion, but with frozen expansion the latter system is superior on an impulse basis.

Similarly, the F_2-H_2 system loses most of its apparent advantage over the O_2-H_2 system, if freezing takes place and performance at high expansion ratios is considered. Freezing of reactions leads to severe performance loss in the $OF_2-B_5H_9$ and $N_2F_4-B_5H_9$ systems.

(3) Certain systems are not very sensitive to mixture ratio in terms of specific impulse. This is especially true of $ClF_3-N_2H_4$ with frozen expansion. (See Figure 3b)

(4) Freezing can have a considerable effect on the optimum mixture ratio. Note that in the $N_2O_4-N_2H_4$ system, at $C = 50$ in a vacuum, the peak shifts from 90 percent to 83 percent N_2O_4 , for a change in oxidizer fuel ratio of 10 to 1, to 6/1.

(5) The density data given on the computer output sheets permit study of density effects. Note, for example, that the greater density at peak of the $ClF_3-N_2H_4$ system relative to the $N_2O_4-N_2H_4$ system would offer considerable advantage.

(6) Oxidizer/fuel ratios at peak performance generally, but not always, shift slightly toward higher values at higher values of area ratio, for both frozen and equilibrium expansion. In general this is also true as chamber pressure is increased. (See summary plots.)

TABLE I

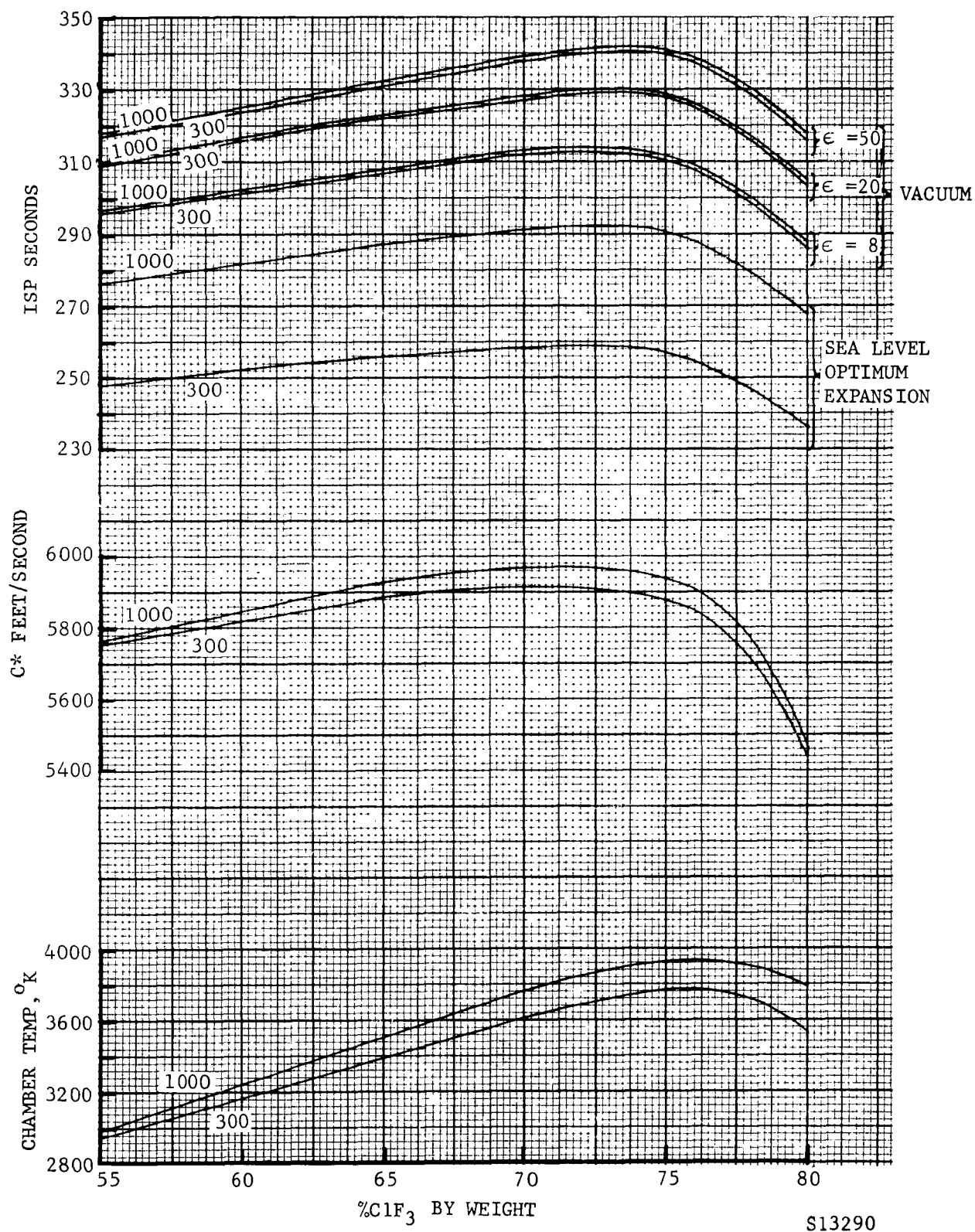
PROPELLANT PERFORMANCE DATA⁽¹⁾

System	Oxid. (2) Density	Fuel (2) Density	(3) T _c , °K	Exp. Cond.	SL I _{OPT} , at % Oxid.	$\epsilon = 8$ I _{VAC} at % Oxid.	$\epsilon = 50$ I _{VAC} at % Oxid.
ClF ₃ -N ₂ H ₄	1.81	1.005	3900 3700	Shift. Froz.	292.5 at 73 279 at 69	314 at 72 300 at 68	342 at 74 322 at 69
F ₂ -H ₂	1.51	0.071	3800 2900	Shift. Froz.	410 at 88 397.5 at 82	440.5 at 88 428 at 81	479 at 90 457 at 83
H ₂ O ₂ -B ₅ H ₉	1.448	0.620	3000 3300	Shift. Froz.	309 at 70 299 at 76	329 at 70 319 at 76	377 at 68 355 at 76
N ₂ F ₄ -B ₅ H ₉	1.500	0.620	4850 4700	Shift. Froz.	333 at 87 308 at 85	357 at 87 331 at 85	402 at 88 357 at 85
N ₂ H ₄ -B ₅ H ₉	1.005	0.620	2800 2800	Shift. Froz.	328 at 56 324 at 58	352 at 56 347 at 58	395 at 56 389 at 57
N ₂ O ₄ -N ₂ H ₄	1.43	1.005	3230 3150	Shift. Froz.	291.5 at 55 283 at 51	312.5 at 55 304.5 at 52	345 at 55 332 at 53
OF ₂ -B ₂ H ₆	1.53	0.445	4600 4400	Shift. Froz.	372 at 78 344 at 75	397 at 78 370 at 74	448 at 78 402 at 75
OF ₂ -B ₅ H ₉	1.53	0.620	4950 4800	Shift. Froz.	359 at 79 331 at 76	384 at 79 356 at 76	436 at 80 387 at 76
OF ₂ -N ₂ H ₄	1.53	1.005	4050 3800	Shift. Froz.	345 at 60 321.5 at 52	370 at 60 346 at 53	413 at 62 373 at 53
O ₂ -H ₂	1.14	0.071	3100 2900	Shift. Froz.	391.5 at 80 388 at 77	421 at 81 416 at 77	461 at 83 454 at 78
O ₂ -RP-1	1.14	0.80	3700 3500	Shift. Froz.	299 at 73 284 at 69	319 at 72 305 at 69	361 at 74 335 at 70

(1) Maxima from Graphs - 1000 psi chamber

(2) In gm/cc.

(3) Approximate value in region of peak performance.



S13290

FIGURE 3a. $\text{C}_1\text{F}_3\text{-N}_2\text{H}_4$ SYSTEM - FROZEN EXPANSION

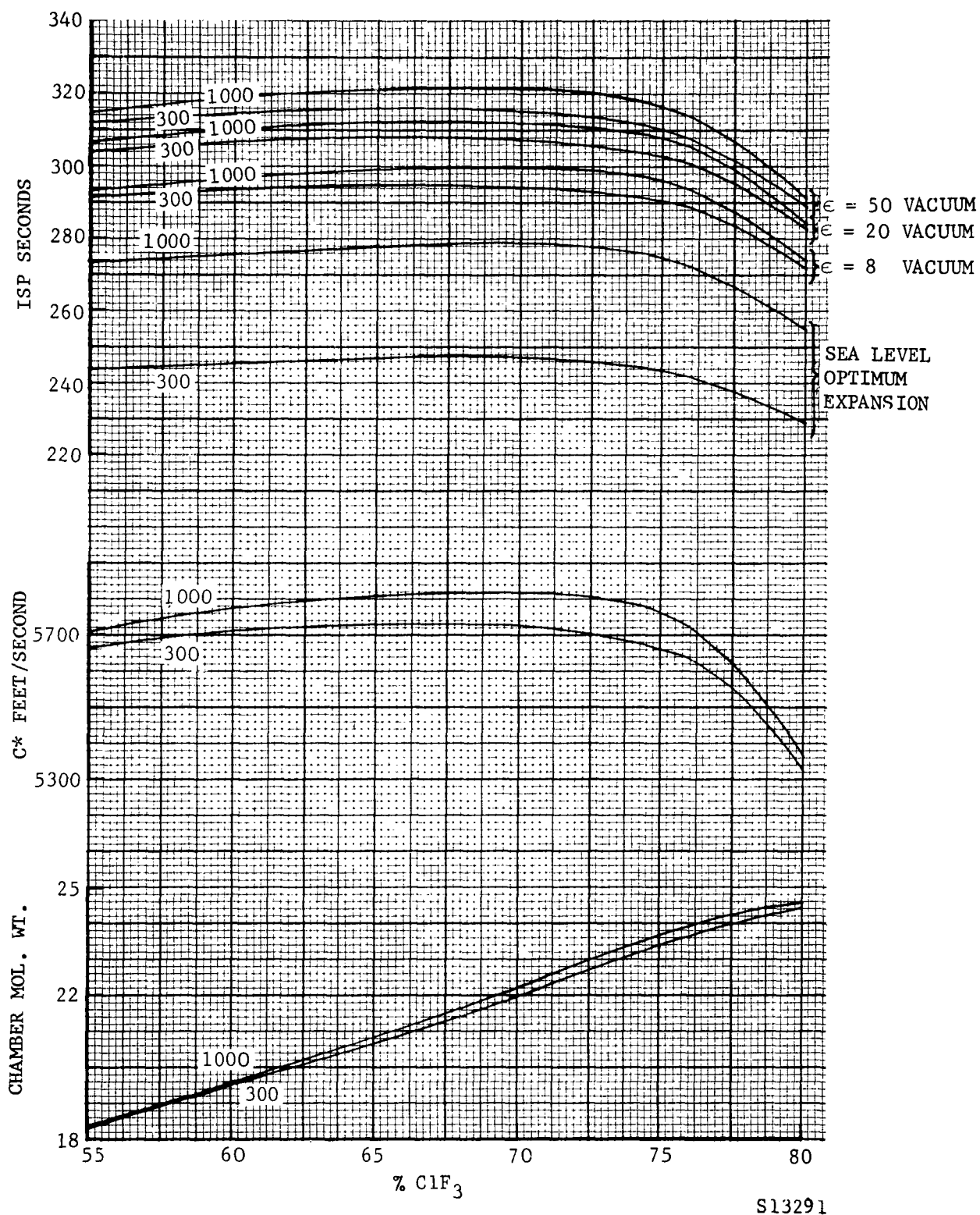
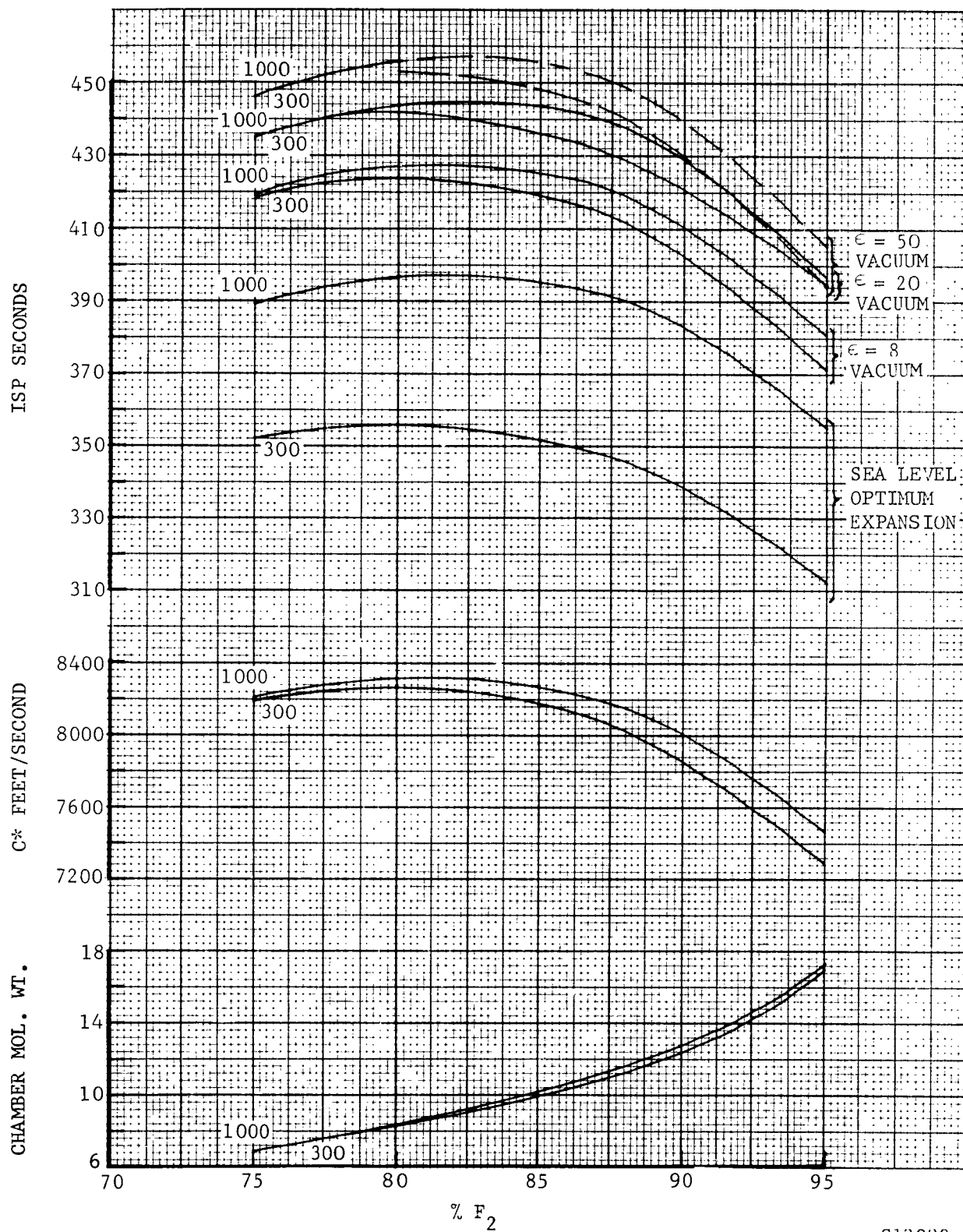
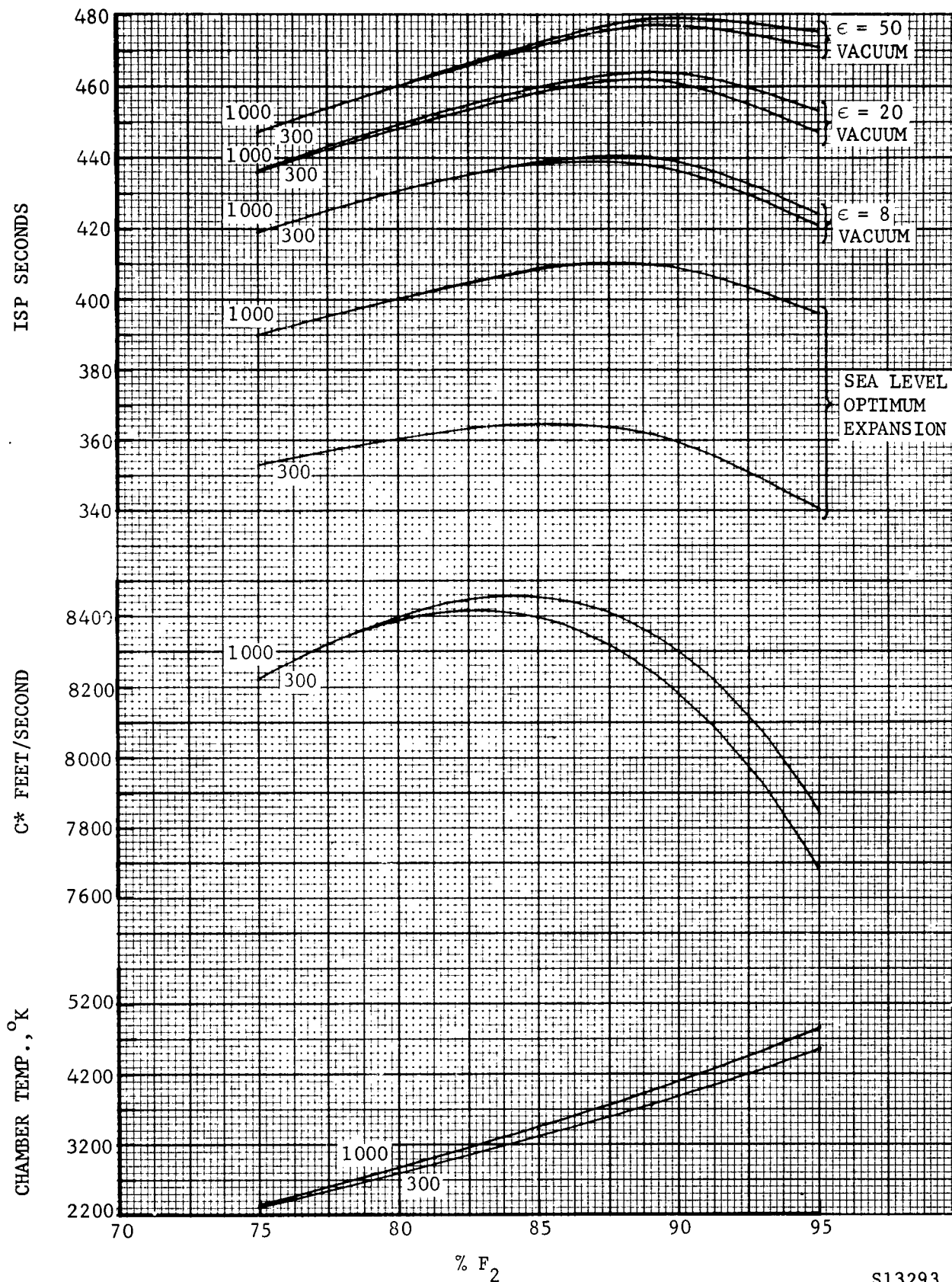


FIGURE 3b. $\text{ClF}_3\text{-N}_2\text{H}_4$ SYSTEM - SHIFTING EXPANSION



S13292

FIGURE 4a. F_2 - H_2 SYSTEM - FROZEN EXPANSION



S13293

FIGURE 4b. F_2 - H_2 SYSTEM - SHIFTING EXPANSION

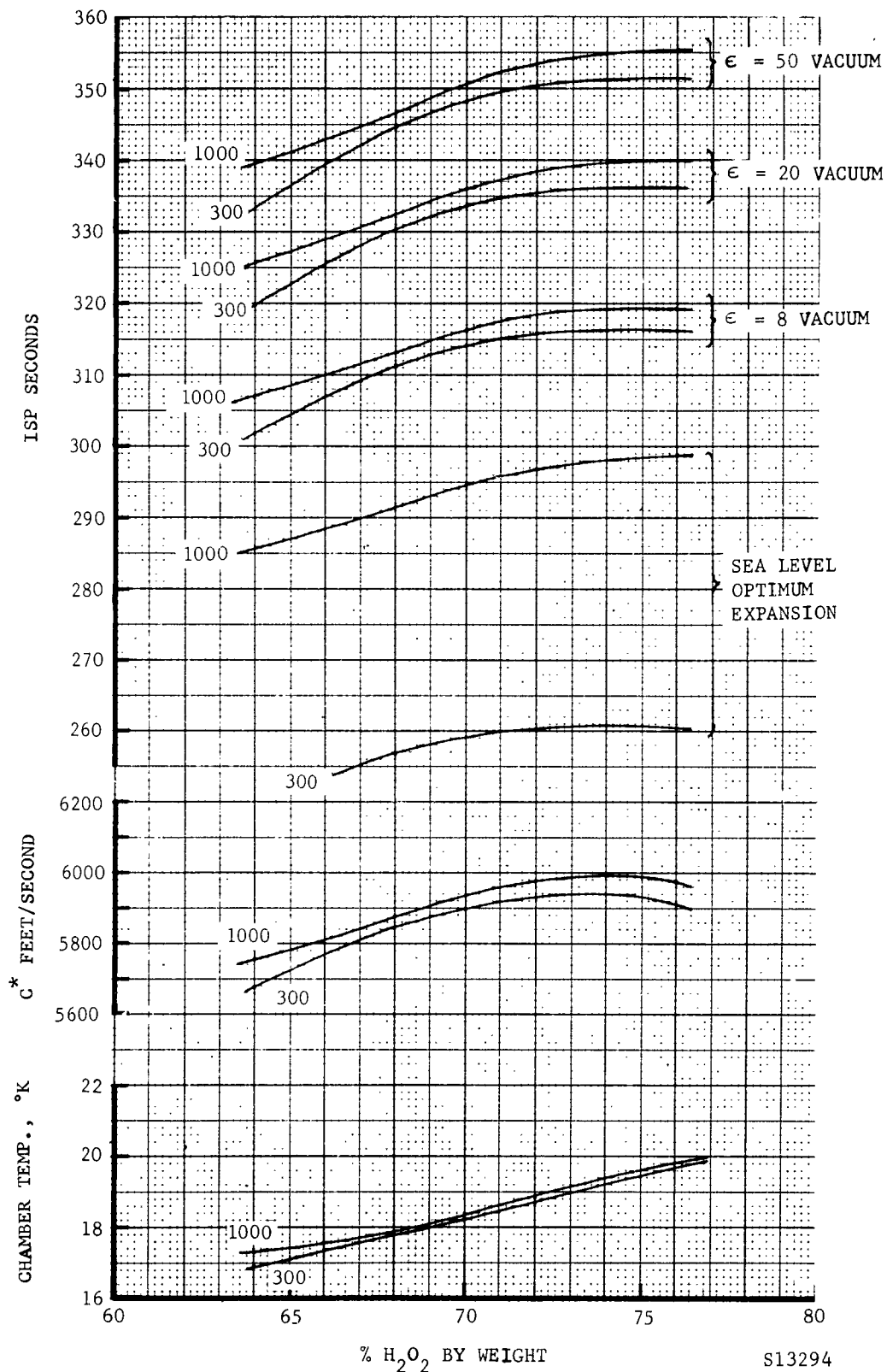
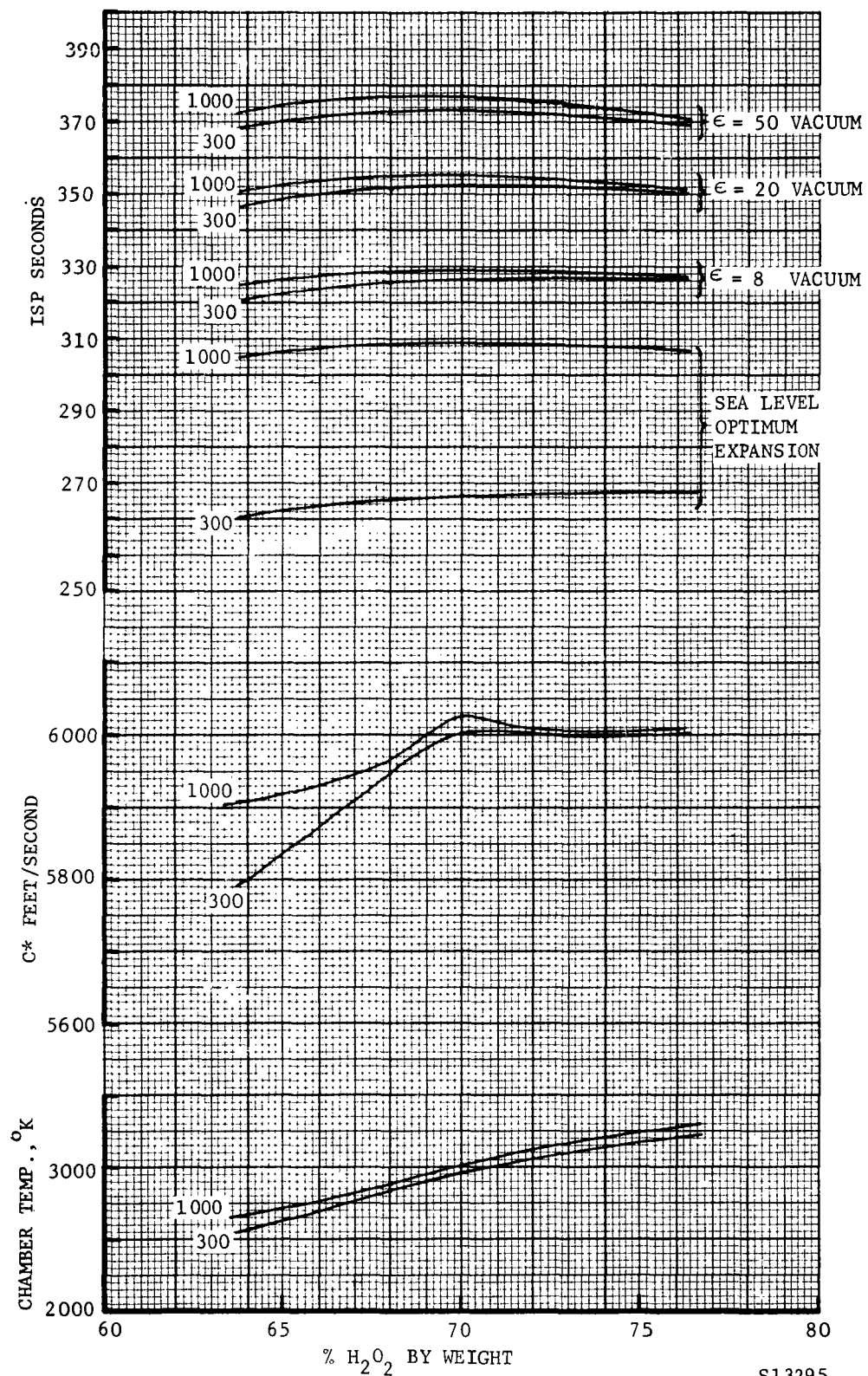


FIGURE 5a. $H_2O_2 - B_5H_9$ SYSTEM - FROZEN EXPANSION



S13295

FIGURE 5b. $H_2O_2 - B_5H_9$ - SHIFTING EXPANSION

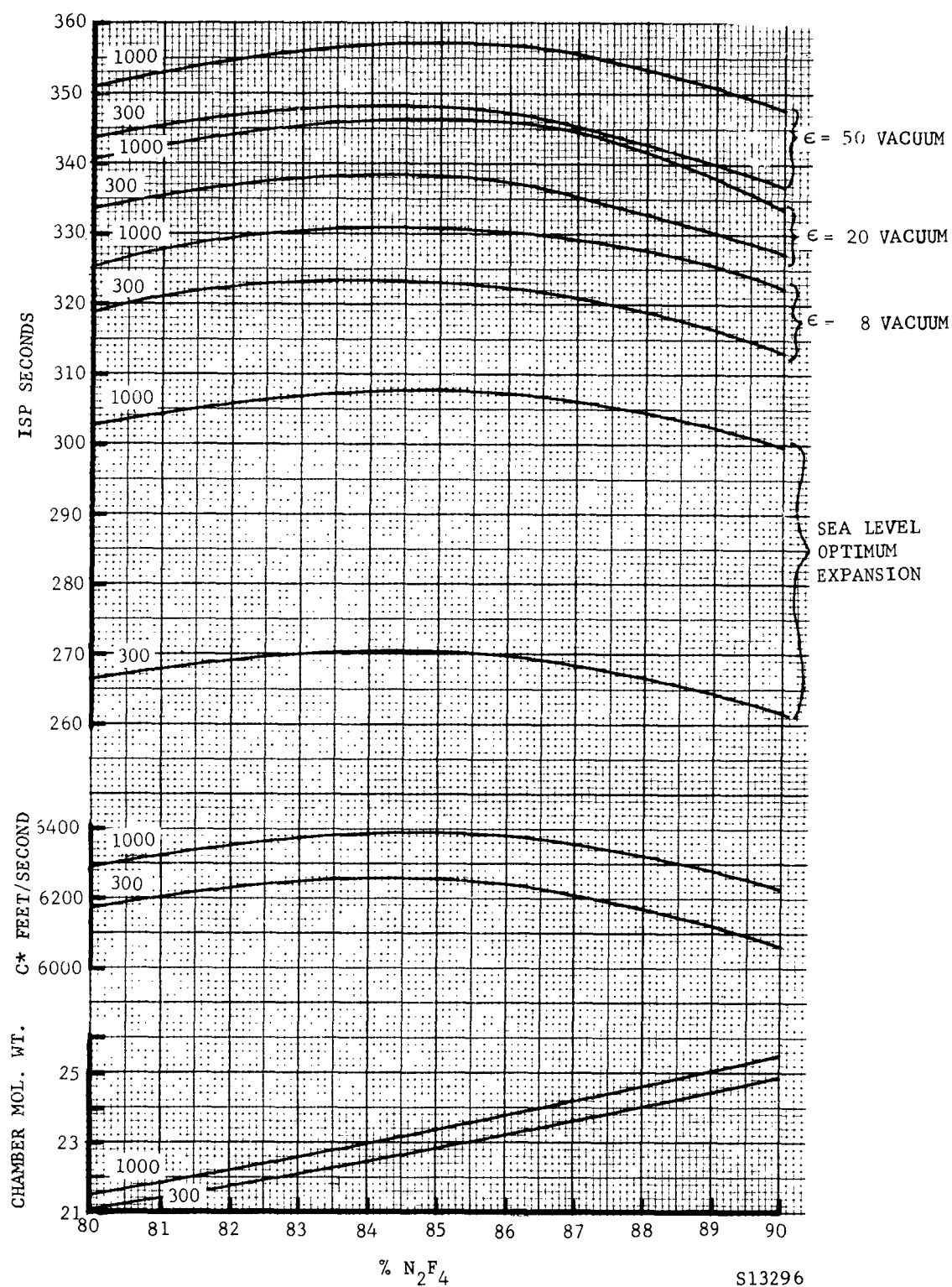


FIGURE 6a. N_2F_4 - B_5H_9 SYSTEM - FROZEN EXPANSION

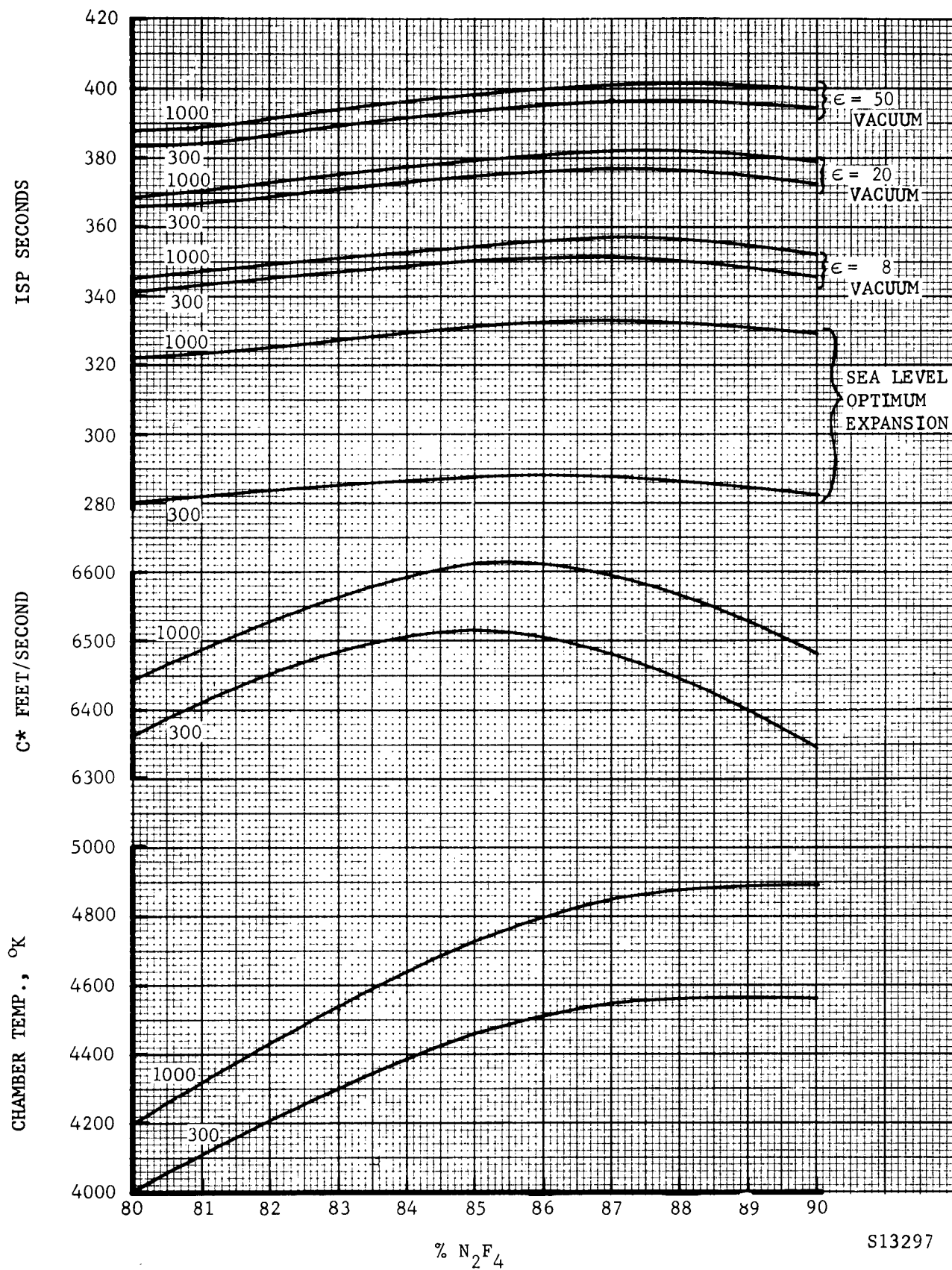


FIGURE 6b. N_2F_4 - B_5H_9 SYSTEM - SHIFTING EXPANSION

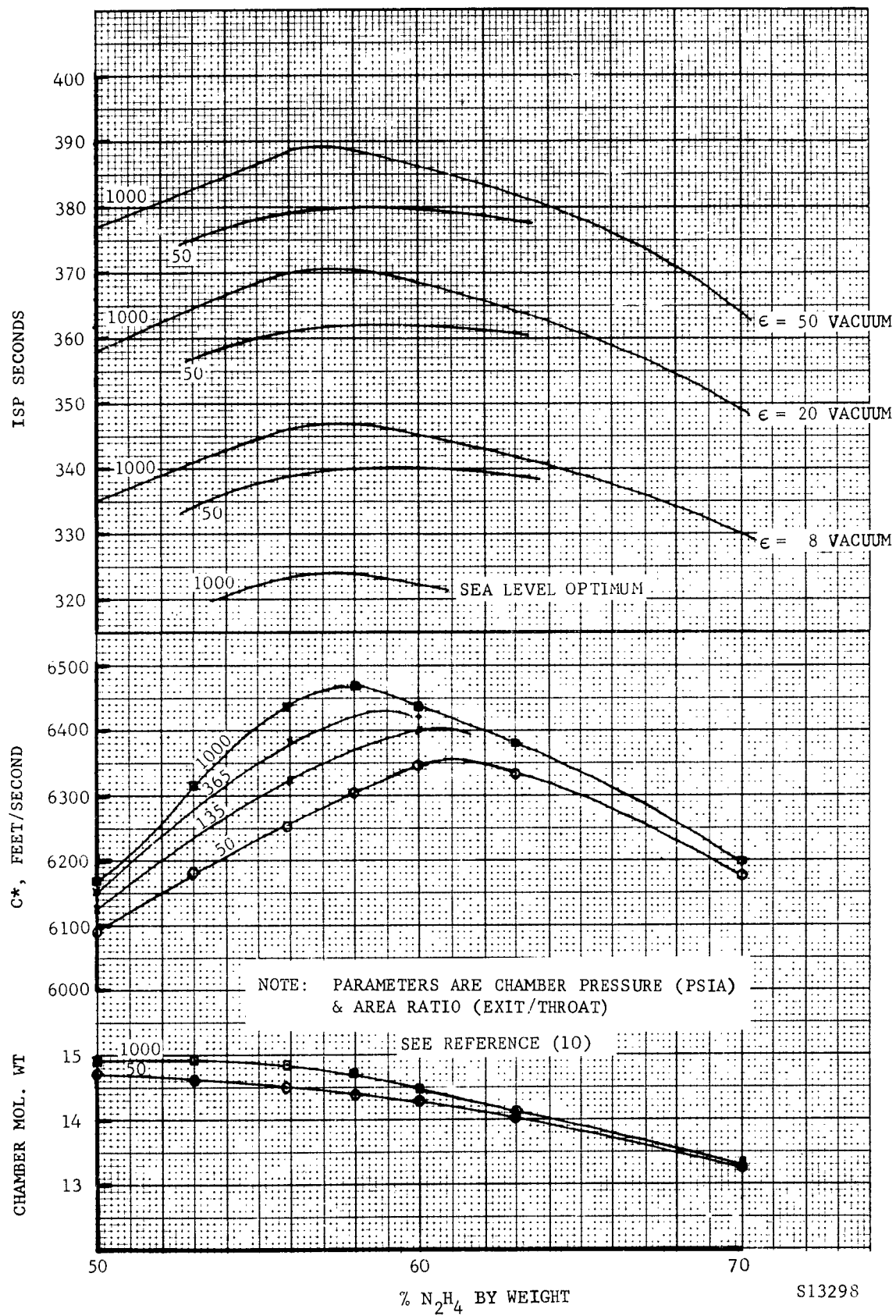
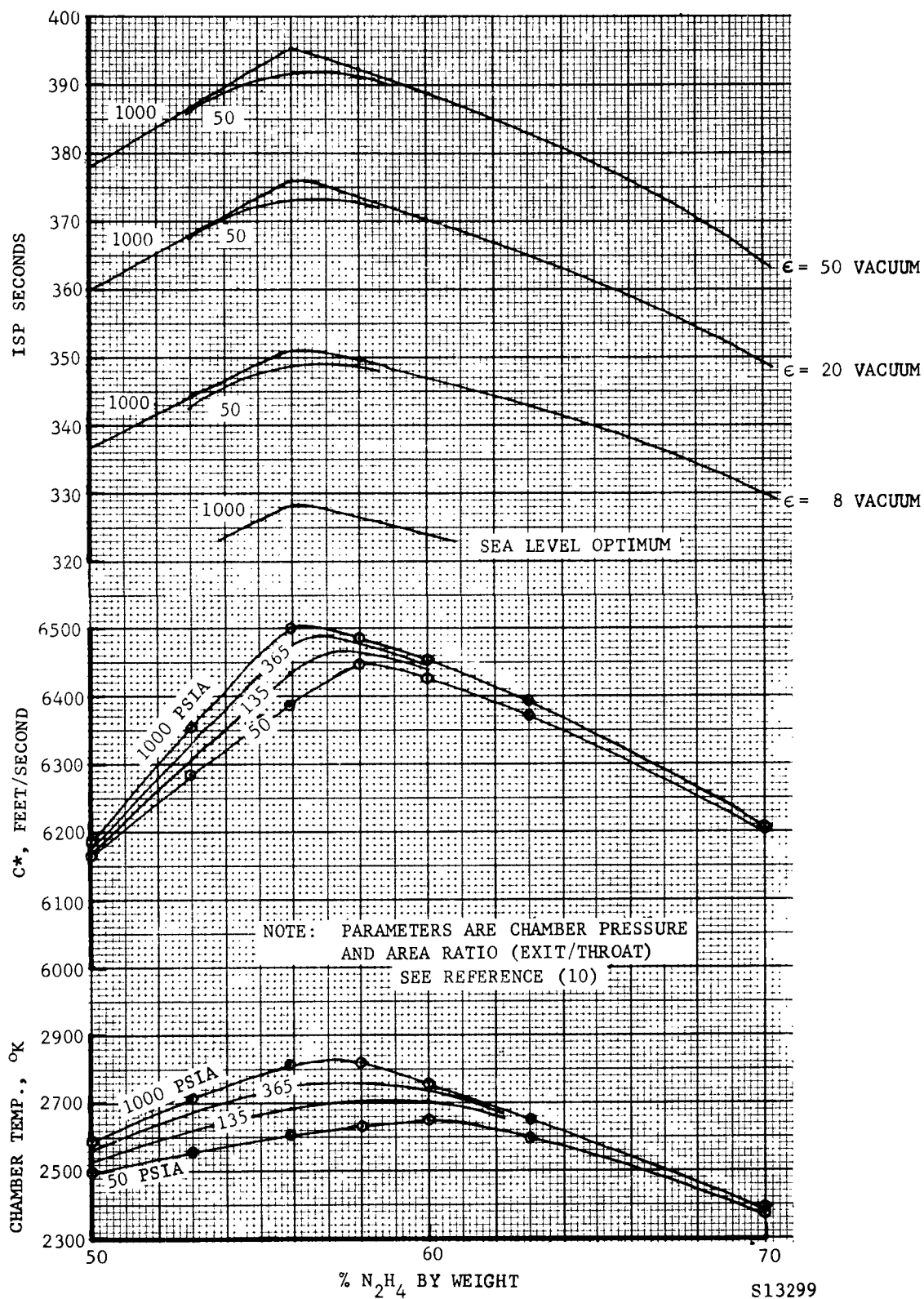


FIGURE 7a. N_2H_4 - B_5H_9 SYSTEM - FROZEN EXPANSION



S13299

FIGURE 7b. N_2H_4 - B_5H_9 SYSTEM - SHIFTING EXPANSION

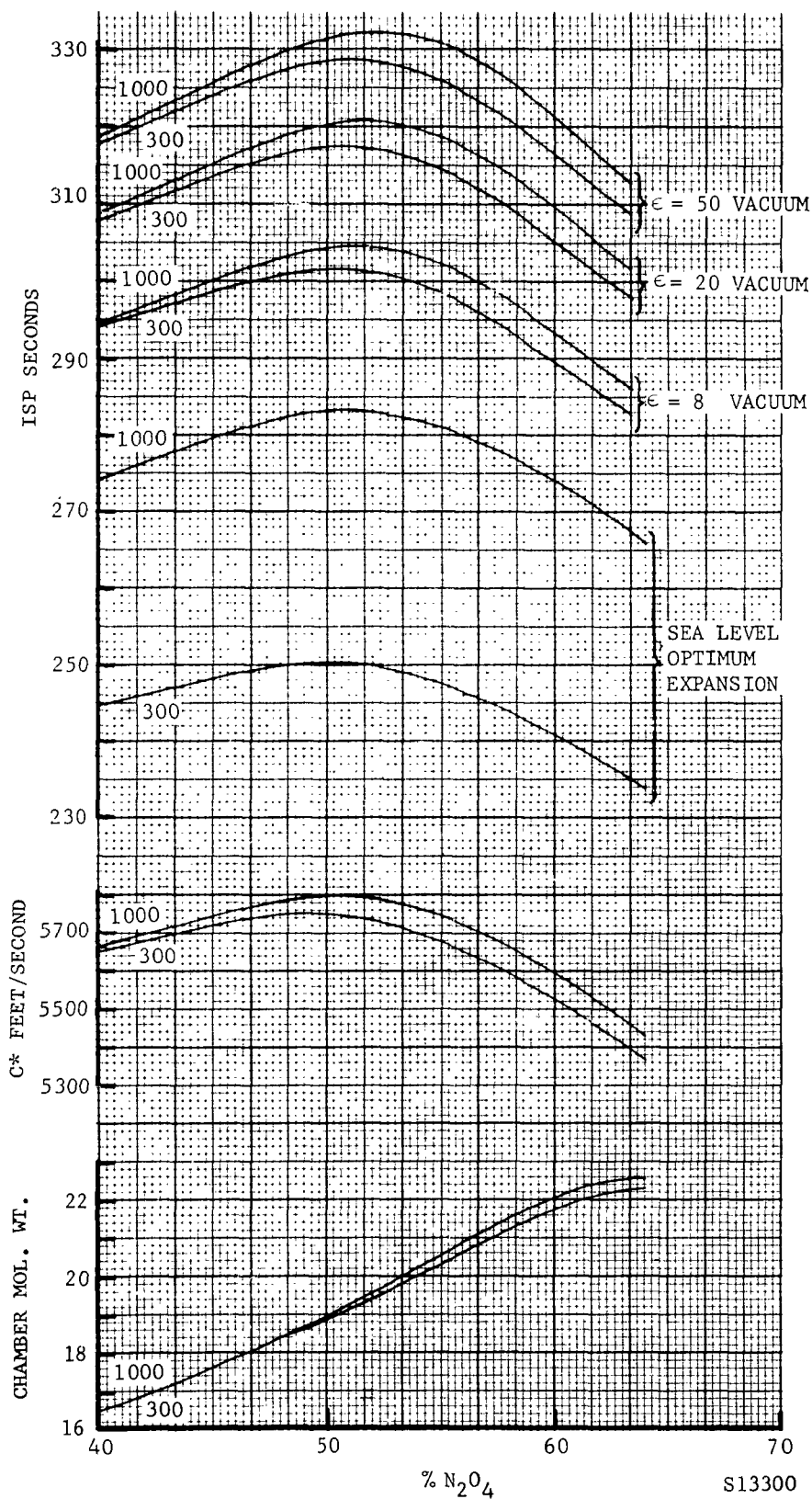
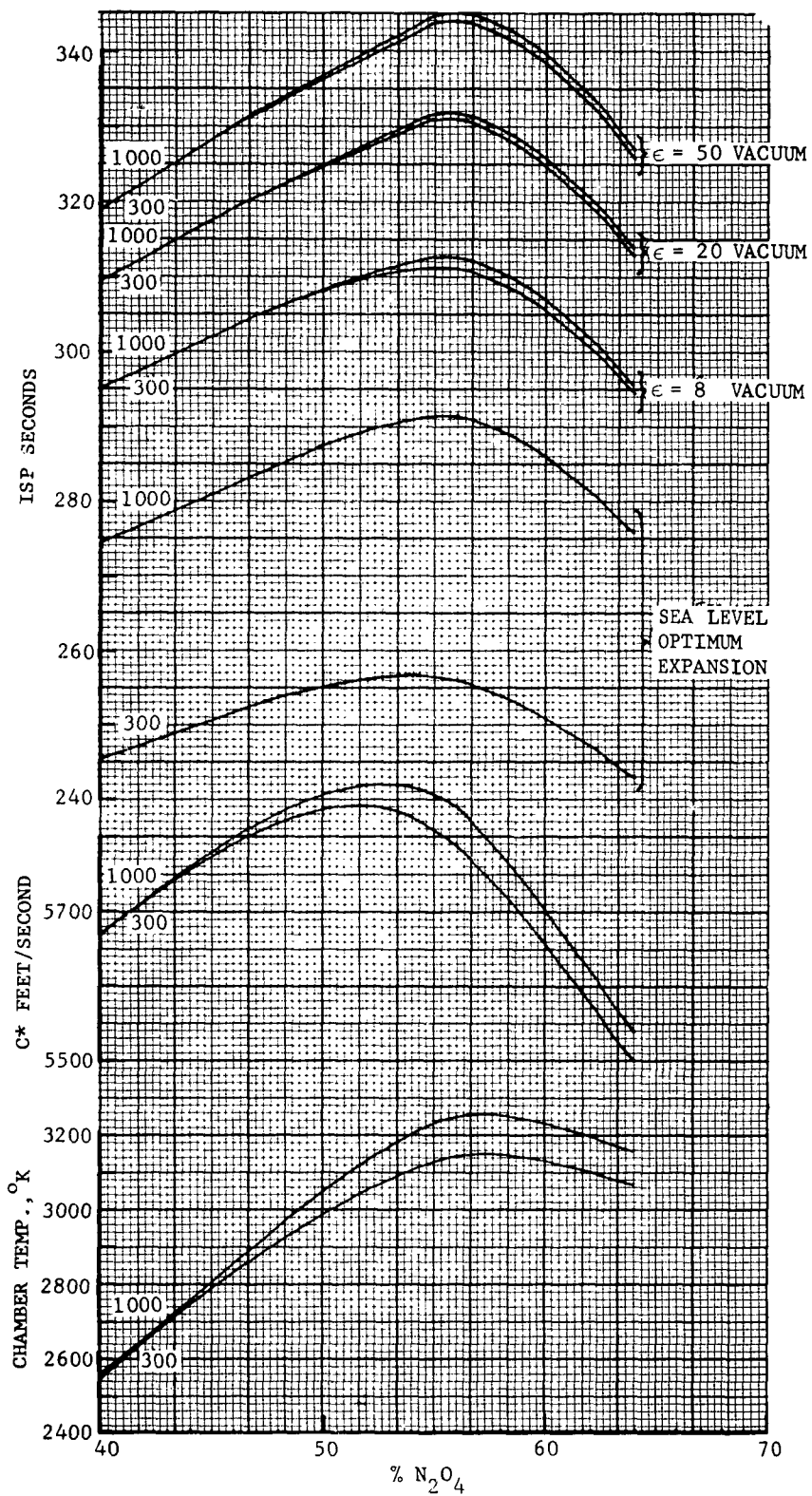


FIGURE 8a. $N_2O_4 - N_2H_4$ SYSTEM - FROZEN EXPANSION



S13301

FIGURE 8b. $N_2O_4 - N_2H_4$ SYSTEM - SHIFTING EXPANSION

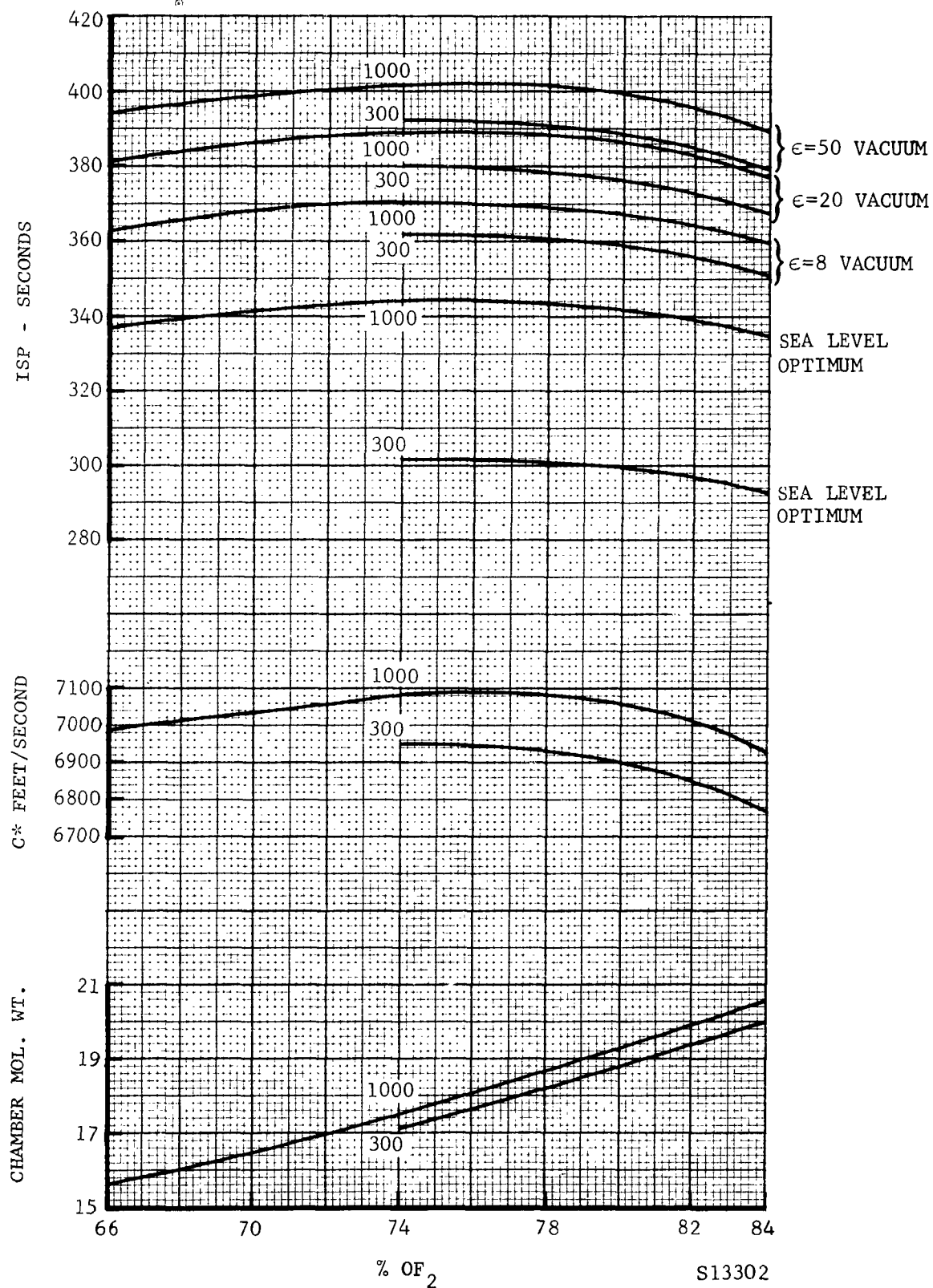


FIGURE 9a. $\text{OF}_2 - \text{B}_2\text{H}_6$ SYSTEM - FROZEN EXPANSION

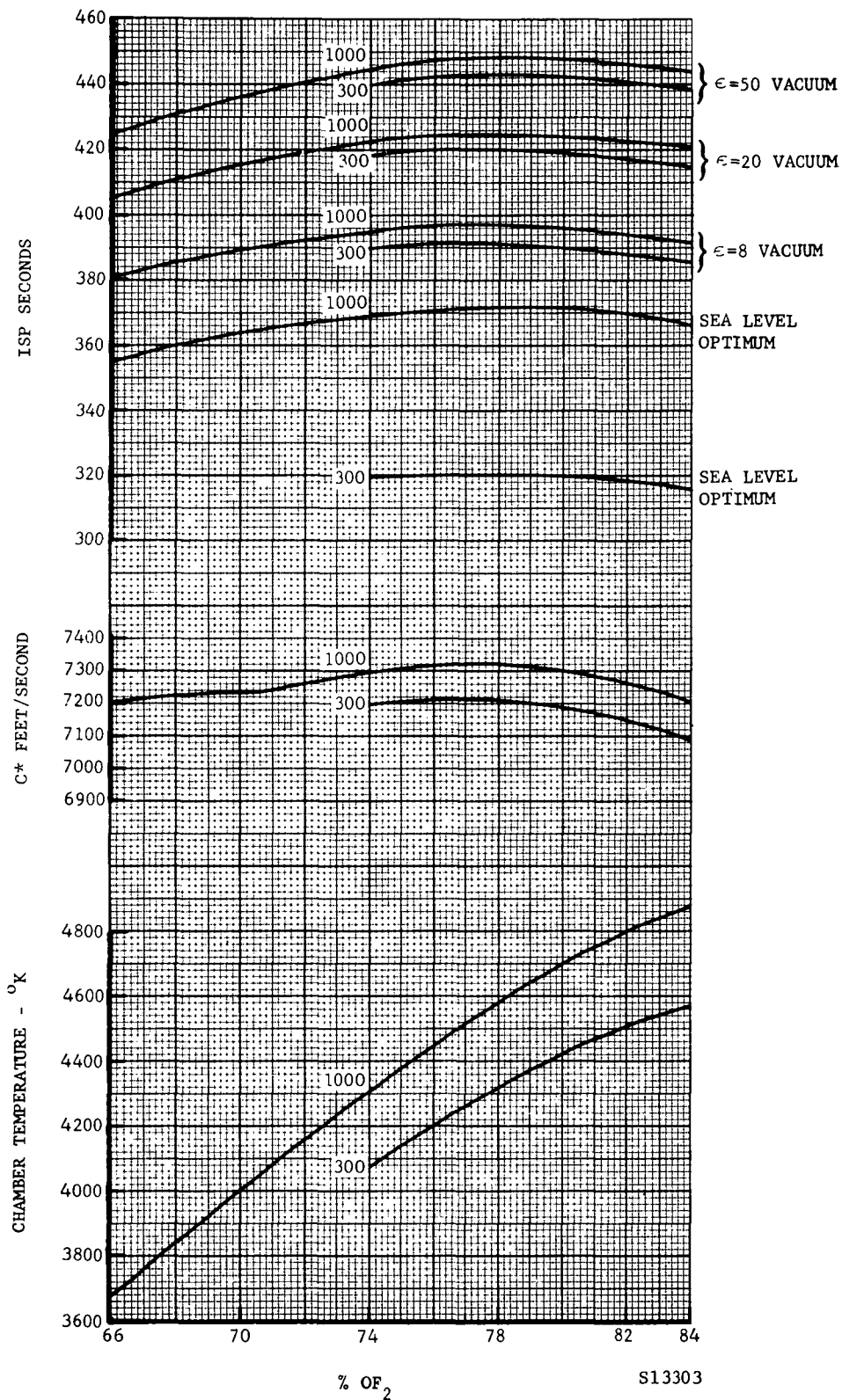


FIGURE 9b. OF_2 - B_2H_6 - SHIFTING EXPANSION

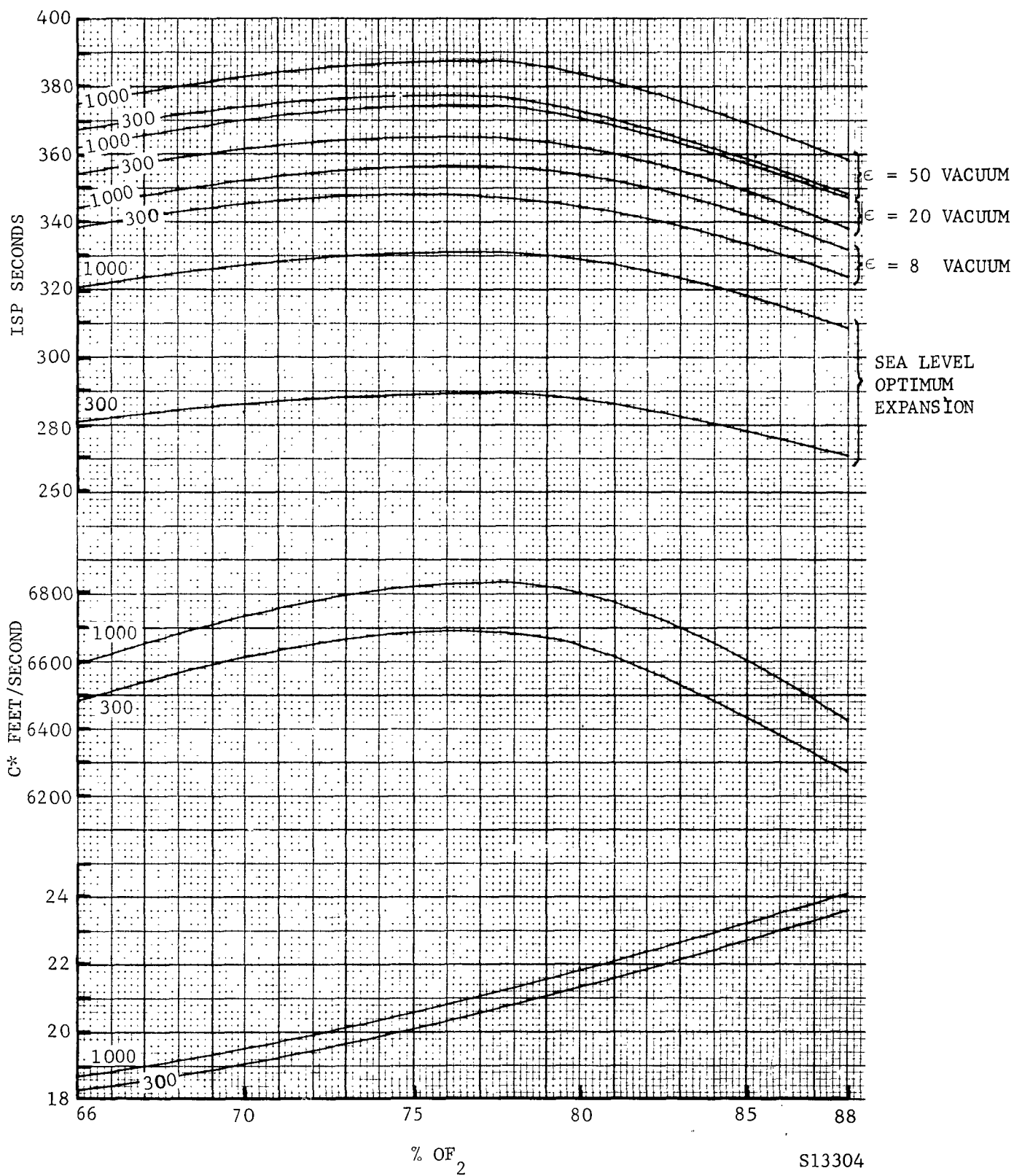


FIGURE 10a. OF_2 - B_5H_9 SYSTEM - FROZEN EXPANSION

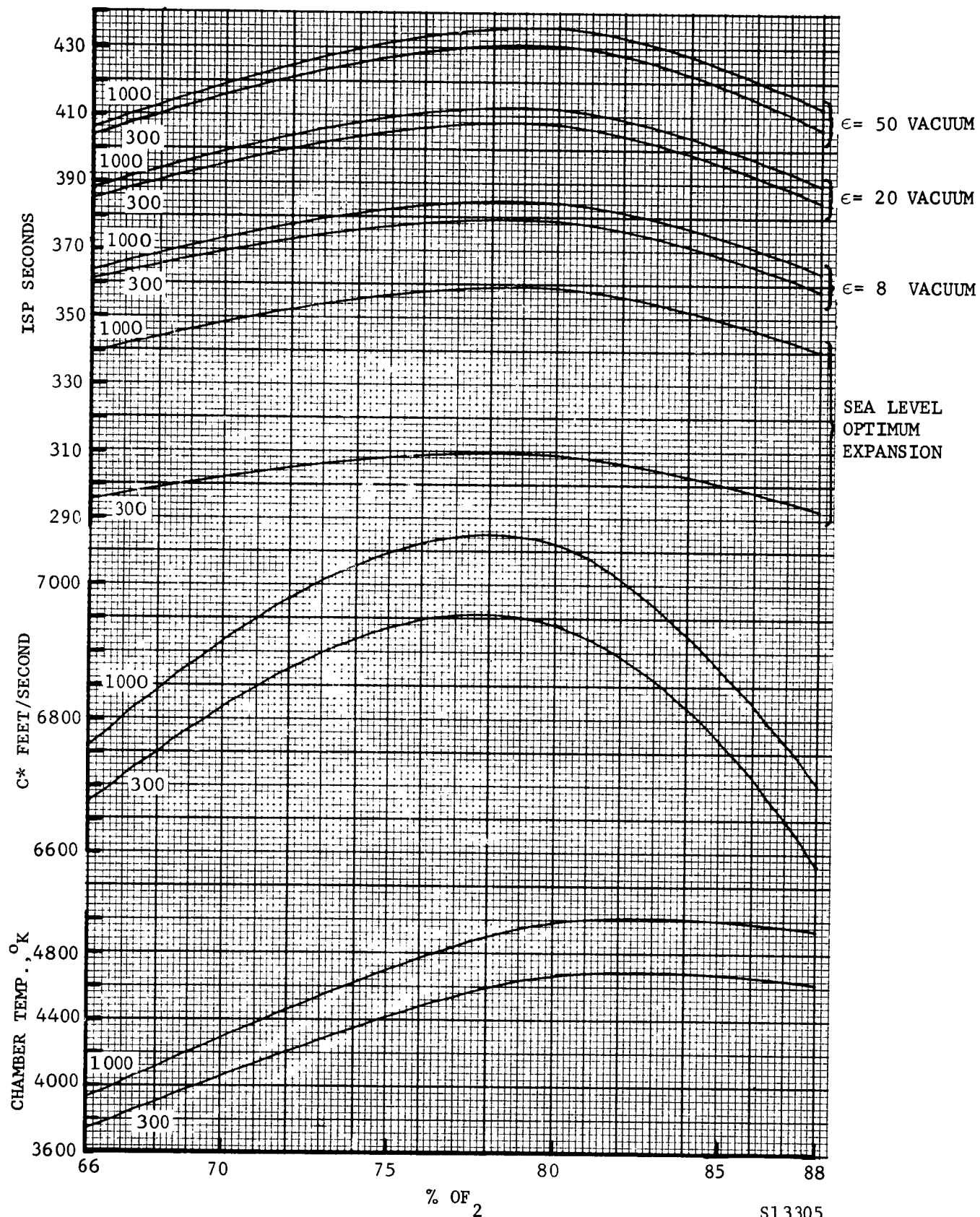
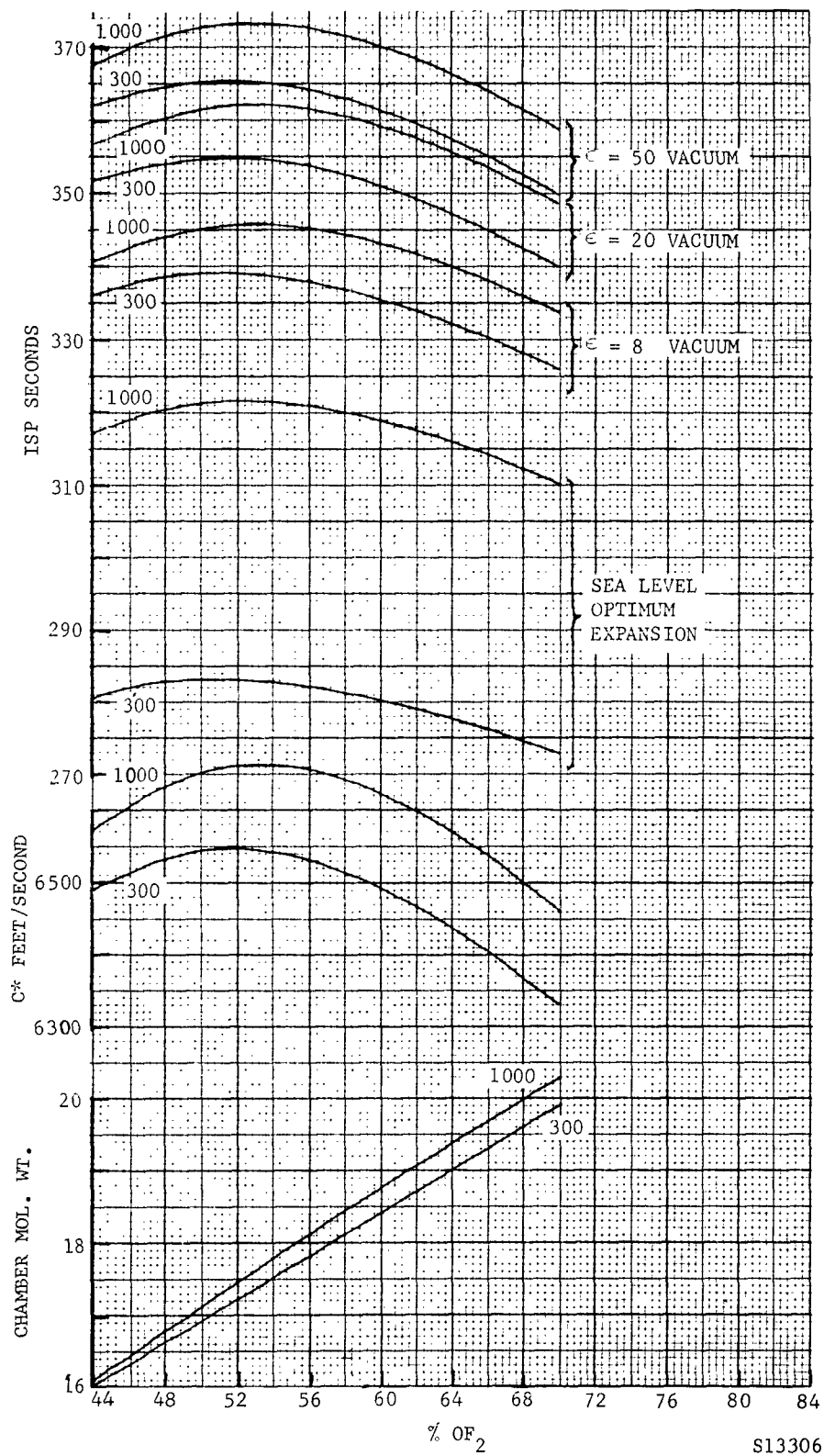


FIGURE 10b. $\text{OF}_2 - \text{B}_5\text{H}_9$ SYSTEM - SHIFTING EXPANSION

S13305



S13306

FIGURE 11a. $\text{OF}_2 - \text{N}_2\text{H}_4$ SYSTEM - FROZEN EXPANSION

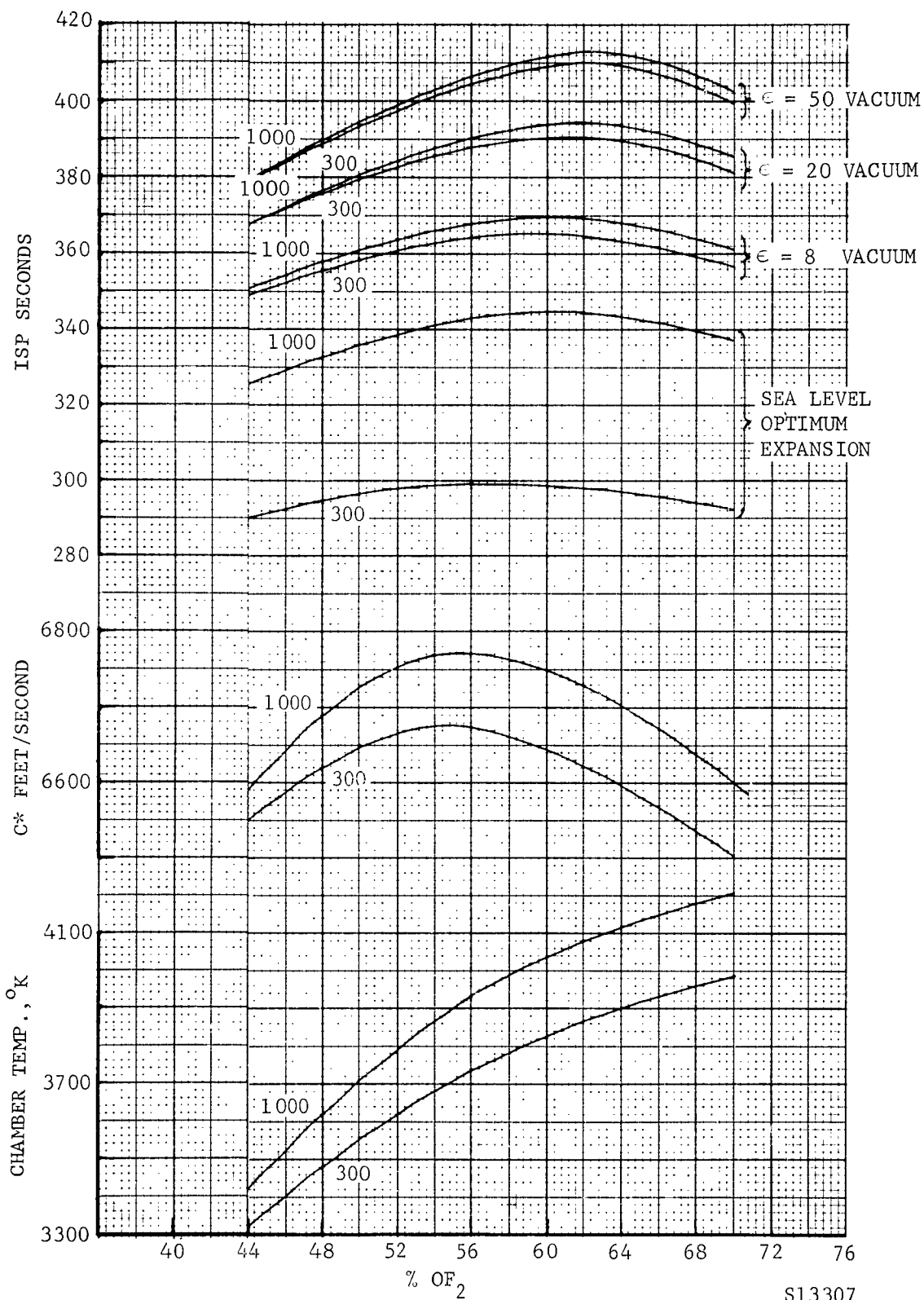


FIGURE 11b. $\text{OF}_2 - \text{N}_2\text{H}_4$ SYSTEM - SHIFTING EXPANSION

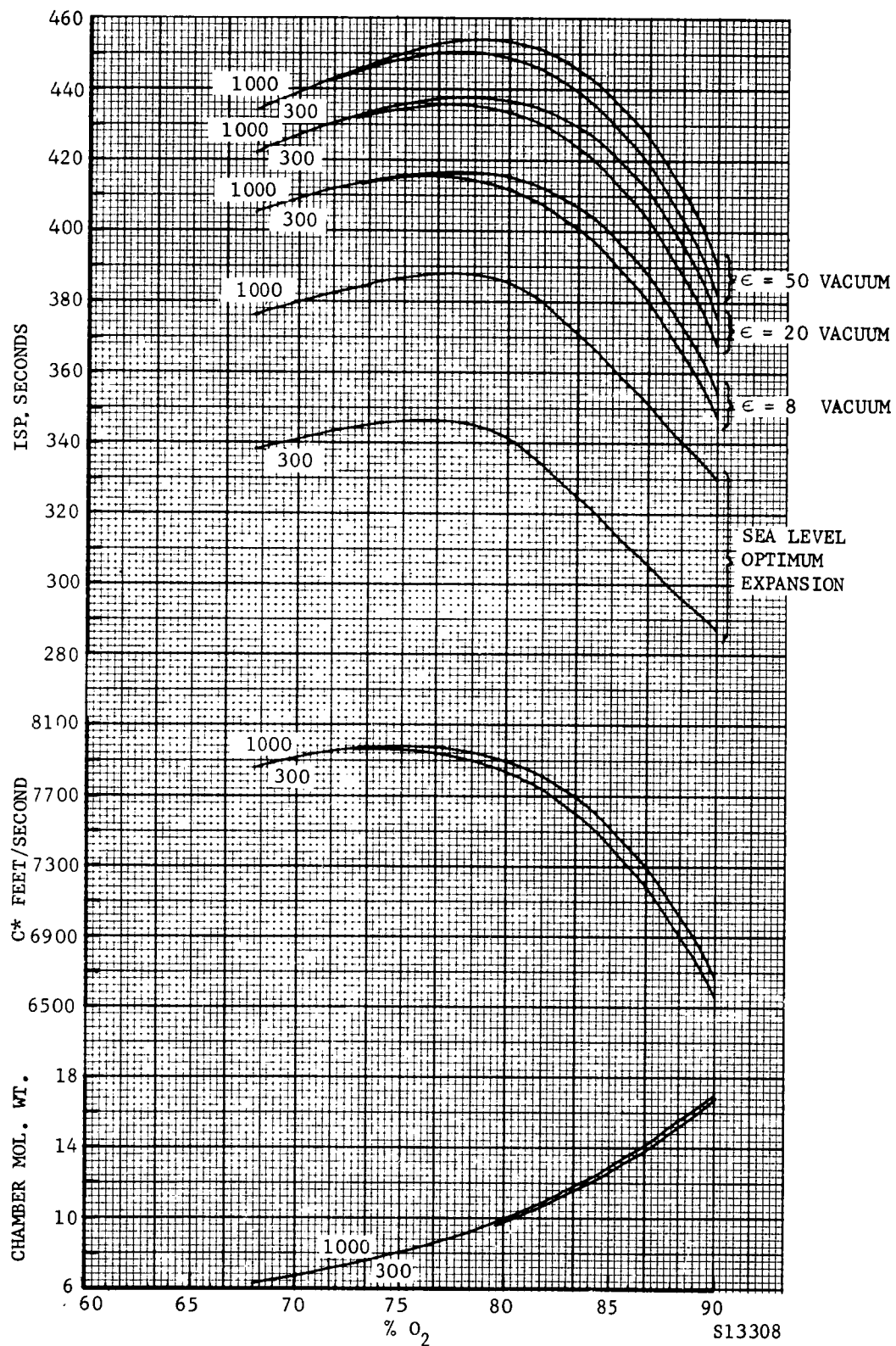


FIGURE 12a. $O_2 - H_2$ SYSTEM - FROZEN EXPANSION

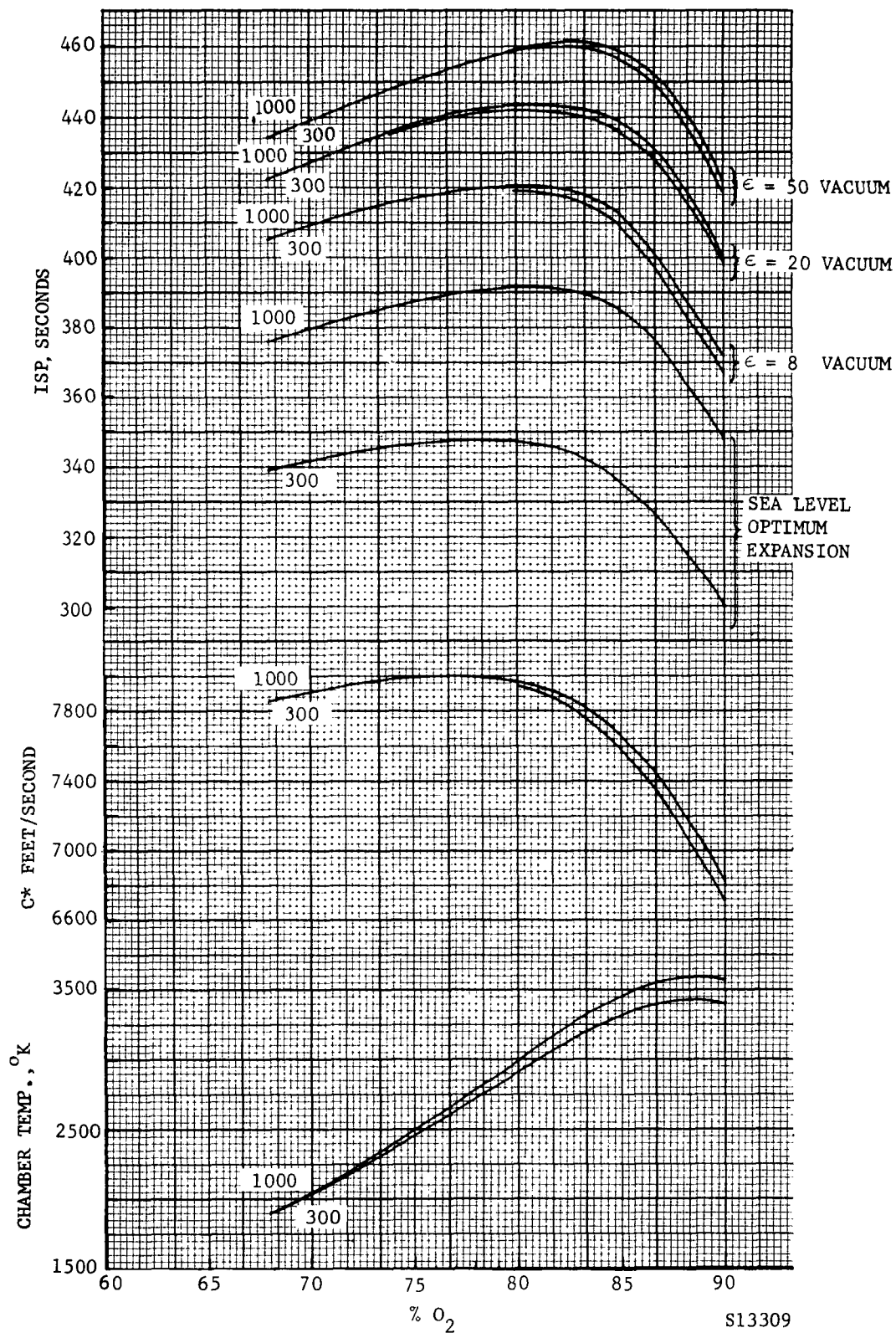
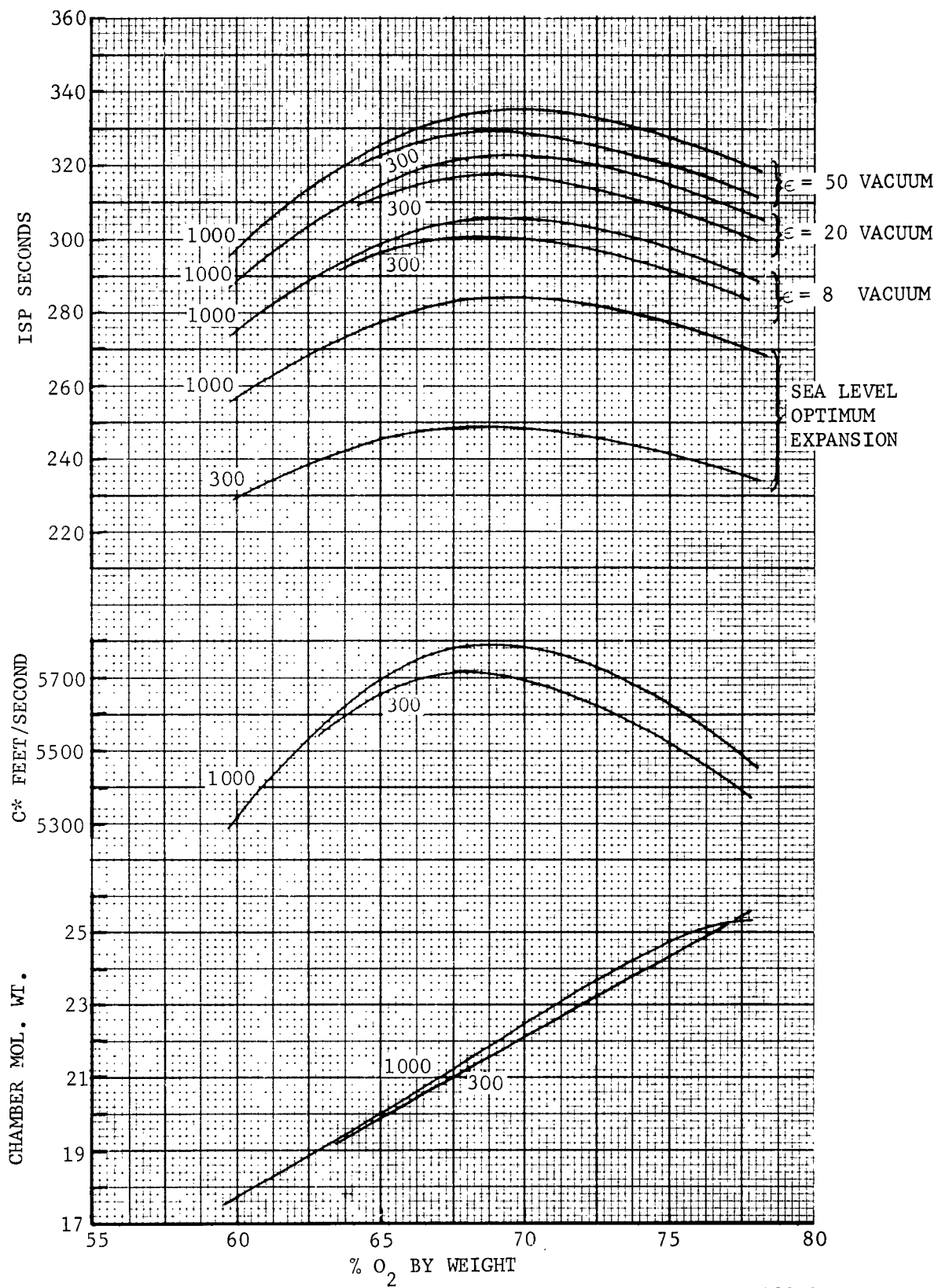
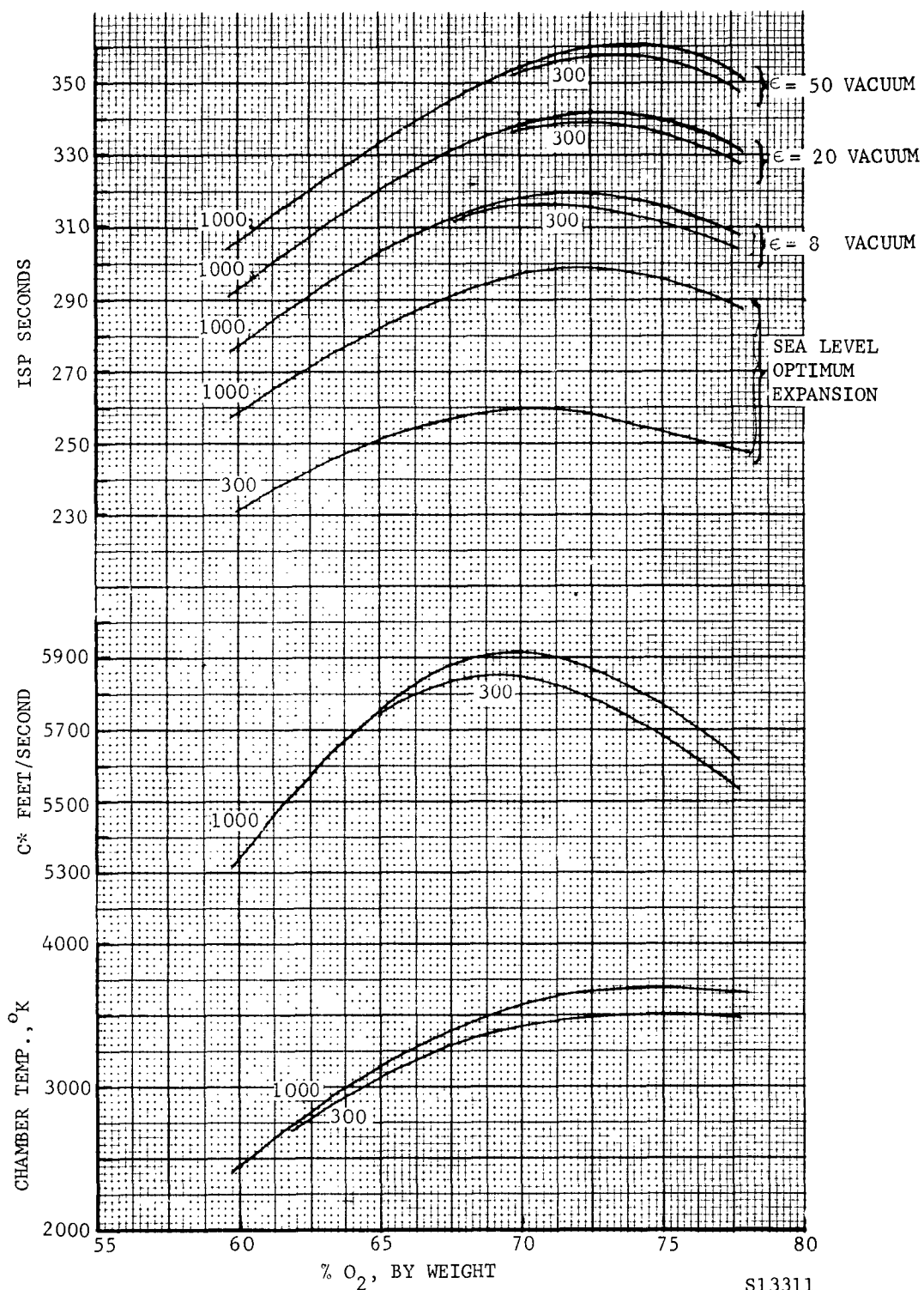


FIGURE 12b. $O_2 - H_2$ SYSTEM - SHIFTING EXPANSION



S13310

FIGURE 13a. O₂ - RP1 SYSTEM - FROZEN EXPANSION



S13311

FIGURE 13b. O₂ - RP1 SYSTEM - SHIFTING EXPANSION

SECTION 5

DETAILED DATA PRESENTATION

PRESENTATION AND NOMENCLATURE FOR MACHINE

In the following, computer output sheets are presented, arranged in order of increasing oxidizer/fuel ratio, with results given first at 1000 psia chamber pressure and then at 300 psia. Two computer output sheets are given for each chamber pressure and mixture ratio. The first computer sheet gives as a heading the mixture data, chamber pressure, heats of formation of propellants, the assumed temperature (the reference temperature) at which each ingredient is fed, the bulk density and the mixture ratio. Following this are the pressure profile data and compositions at each profile point. The second page gives performance data at interpolated whole number values of area ratio for both frozen and shifting expansion, from 1 through 50, and at sea level optimum expansion. All results assume zero divergence angle.

Nomenclature used is as follows:

TREF, DEG K	= propellant feed temperature, °K.
CHAMBER ENTROPY	= EU/100 grams = cal/100 grams -°K.
ENTHALPY (-)	= the negative of the enthalpy, kcal/100 gms of combustion products
CP	= specific heat at constant pressure, cal/gm-°K.
X BAR	= moles of gas per 100 grams of combustion products.

N	= total moles per 100 grams of propellant including the moles of condensed phase.
P_c/P	= chamber pressure divided by exhaust pressure.
I OPT	= specific impulse assuming the ambient pressure equals the exhaust pressure (optimum expansion)
DELVAC	= increment in specific impulse between I OPT and specific impulse under vacuum conditions.
DELVAC/P	= DELVAC divided by exhaust static pressure.
I SEA LVL	= specific impulse at the specified area ratio assuming a 14.696 psia ambient.
I AT 10000	= specific impulse at the specified area ratio assuming a 10.26 ₉₅ psia ambient.
I AT 50000	= the same, assuming a 1.70 ₅₈ psia ambient.
I VAC	= the same, assuming a vacuum ambient.
CF SEA LVL	= thrust coefficient at the specified area ratio at sea level.
CF VAC	= thrust coefficient at the specified area ratio under vacuum conditions.

Blanks are shown in C_p values where interpolation is thought to be hazardous. In these cases heat capacity as a function of area ratio or exhaust pressure can be estimated by examining the original pressure profile data (the first page of the output). The reasons for this were discussed in Section 3.

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$\text{ClF}_3 - \text{N}_2\text{H}_4$ SYSTEM

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 298 CL*F3 1.882 -44.35 55.
 298 N2*H4 1.004 12.05 45.

BULK DENSITY = 1.35 GM/CC
 MIXTURE RATIO = 1.222 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 279.73 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	546.5
TEMP, DEG K	2979.7	2410.2	1936.9	1544.3	1219.8	1058.7	954.5	740.9	571.9	440.0	338.5	258.3	2594.3
ENTHALPY (-)	9.46	36.19	57.74	74.97	88.69	95.27	99.46	107.85	114.35	119.56	124.19	126.21	27.63
CP	.4753	.4626	.4475	.4309	.4132	.4045	.3986	.3878	.3813	.3706	.3667	.3752	.4671
IMPLV OPT		152.48	204.93	238.76	262.53	273.22	279.80	292.56	302.07	309.20	314.55	318.69	325.71
IMPLV VAC		226.75	249.34	269.15	284.36	291.43	295.85	304.46	310.97	315.89	319.60	322.49	322.68
EPSILON		1.051	1.579	2.715	4.898	6.983	9.034	16.846	31.632	59.719	113.441	214.652	1.000
	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	553.3
TEMP, DEG K	2979.7	2464.9	1998.7	1599.1	1266.4	1100.7	993.4	772.8	598.0	464.6	425.8	407.2	2644.5
ENTHALPY (-)	9.46	36.44	58.47	76.20	90.32	97.12	101.44	110.13	116.87	122.09	126.34	130.28	27.40
X BAR	5.435	5.410	5.403	5.402	5.402	5.402	5.402	5.402	5.400	5.387	5.228	5.048	5.416
N	5.435	5.410	5.403	5.402	5.402	5.402	5.402	5.402	5.400	5.387	5.228	5.162	5.416
CP	.5885	.5016	.4559	.4333	.4151	.4061	.4000	.3889	.3857	.4272	18.0967	20.4274	.5276
IMPLV OPT		153.20	206.49	240.95	265.22	276.14	282.87	295.94	305.68	313.02	318.87	324.19	324.92
IMPLV VAC		228.45	251.70	271.95	287.52	294.76	299.27	308.13	314.82	319.93	324.91	329.68	324.04
EPSILON		1.055	1.592	2.742	4.955	7.071	9.155	17.099	32.167	61.149	134.133	305.953	1.000
	COMPOSITION SHIFTING (MOL/100 GM)												
2H.92 CL	.0134	.0033	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0058
-13.50 CL*F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-38.87 CL*F3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-21.97 CL*H	.5814	.5916	.5945	.5948	.5949	.5949	.5949	.5949	.5949	.5949	.5949	.5949	.5891
.00 CL2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
1H.86 F	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-64.50 F*H	1.7842	1.7846	1.7846	1.7846	1.7846	1.7846	1.7846	1.7846	1.7846	1.7846	1.7846	1.7846	1.7845
58.60 F*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.0577	.0122	.0014	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0020
79.20 F*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	1.5988	1.6139	1.6179	1.6184	1.6184	1.6183	1.6183	1.6178	1.6154	1.5954	1.5130	1.4283	1.6103
40.30 F2*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3*N	.0002	.0001	.0001	.0001	.0001	.0001	.0002	.0005	.0021	.0154	.0185	.0130	.0001
113.00 N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	1.4040	1.4041	1.4041	1.4041	1.4041	1.4041	1.4041	1.4039	1.4031	1.3964	1.3690	1.3407	1.4041
-75.38 CL*H4*N/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0519	.1138	.0000

SYSTEM LIQUID BIPROPELLANT										PC 1000. PSIA									
COMPONENT										DENSITY									
LEG K										GP/CC									
298 CL+F3										1.88									
298 N2+H2O										12.05									
FROZEN EXPANSION										HEAT FORM									
C STAK + 5708.8 FI/SEC										[KCAL/FORM.WT.]									
										55.									
										45.									
</																			

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000 PSIA
 COMPONENT IMEF FORMULA DENSITY HEAT FORM WT. O/O
 LEG K GM/CC (KCAL/FORM.WT.)
 298 CL*F3 1.88 -44.35 65.
 298 H2*H4 1.004 12.05 35.

BULK DENSITY = 1.440 GM/CC
 MIXTURE RATIO = 1.85/ LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTRUPY 257.98 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	543.9
TEMP, DEG K	3502.4	2834.3	2281.4	1823.9	1446.2	1258.1	1136.0	884.2	683.1	525.2	403.0	309.0	3046.7
ENTHALPY (-)	18.02	45.71	68.06	86.00	100.29	107.18	111.57	120.49	127.23	132.50	136.54	139.64	36.98
CP	.4190	.4095	.3943	.3852	.3705	.3619	.3563	.3442	.3363	.3319	.3301	.3289	.4128
IMPELL CPT	155.20	208.65	243.19	267.53	279.51	285.27	298.42	308.23	315.58	321.11	325.28	328.42	
IMPELL VAC	230.85	253.94	274.26	289.92	297.22	301.77	310.69	317.41	322.47	326.30	329.21	328.67	
EPSILON	1.052	1.542	2.725	4.934	7.047	9.129	17.067	32.058	60.472	114.543	217.774	1.000	
	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	558.3
TEMP, DEG K	3502.4	2992.6	2501.5	2039.6	1634.7	1429.8	1295.9	1017.5	791.9	612.5	472.3	404.1	3177.1
ENTHALPY (-)	18.02	46.28	69.95	89.40	105.10	112.73	117.61	127.48	135.20	141.19	145.82	149.48	36.46
X HAK	4.791	4.728	4.695	4.684	4.682	4.682	4.682	4.682	4.682	4.682	4.681	4.599	4.748
N	4.791	4.728	4.695	4.684	4.682	4.682	4.682	4.682	4.682	4.682	4.681	4.625	4.748
CP	.6899	.5641	.4594	.4016	.3773	.3676	.3614	.3477	.3371	.3313	.3329	13.0082	.6102
IMPELL CPT	156.40	212.55	249.19	275.23	287.05	294.35	308.59	319.29	327.34	333.43	338.17	342.66	
IMPELL VAC	234.81	260.41	282.34	299.28	307.21	312.17	321.94	329.32	334.91	339.16	342.92	342.92	229.62
EPSILON	1.063	1.634	2.848	5.190	7.440	9.664	18.179	34.348	65.087	123.733	257.640	1.000	
	COMPOSITION SHIFTING (WCL/100 GM)												
28.92 CL	.0766	.0342	.0075	.0013	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0480
-13.50 CL*F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-38.87 CL*F3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-21.97 CL*H	.6260	.6687	.6935	.7017	.7029	.7030	.7030	.7030	.7030	.7030	.7030	.6769	.6548
.00 CL2	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
18.86 F	.0057	.0011	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0021
-64.50 F*H	2.1034	2.1080	2.1090	2.1091	2.1091	2.1091	2.1091	2.1091	2.1091	2.1091	2.1091	2.1091	2.1070
58.60 F*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.1359	.0562	.0147	.0019	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0811
79.20 F*N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.7514	.7677	.7757	.7774	.7781	.7781	.7781	.7781	.7781	.7781	.7781	.7781	.7627
40.30 F2*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	1.0920	1.0921	1.0921	1.0921	1.0921	1.0921	1.0921	1.0921	1.0921	1.0921	1.0921	1.0921	1.0921
-75.38 CL*F4*H/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0262	.0000

PRESSURE PROFILE DATA
 SYSTEM LIQUID: HIPROPELLANT PC 1000 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. C/B
 (EG K GM/CC (KCAL/FORM.WT.)
 29H CL-F1 1.88 -44.45 70.
 29H N2-H4 1.004 +12.05 50.

BULK DENSITY = 1.543 GM/CC
 MIXTURE RATIO = 2.333 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 245.90 EU/100GMS

CHAMBER

THRUST

	FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	543.4
TEMP, DEG K	3750.3	3029.4	2434.8	1944.7	1541.4	1340.7	1210.5	941.9	727.1	558.3	427.5	327.4	3257.0
ENTHALPY (-)	22.30	50.00	12.47	90.42	104.70	111.59	115.97	124.74	131.61	136.87	140.90	143.98	41.35
CP	.3894	.3810	.3715	.3603	.3474	.3345	.3236	.3122	.3011	.2905	.2805	.2704	.3840
IMPELL OPT	155.45	208.92	243.43	267.13	278.70	285.46	298.58	304.37	315.70	321.21	323.35	328.75	128.75
IMPELL VAC	231.15	254.19	274.47	290.10	297.39	301.93	310.84	317.53	322.57	326.38	329.26	331.03	227.03
EPSILON	1.051	1.579	2.719	4.922	7.030	9.107	11.017	12.949	14.891	16.795	18.616	20.350	1.000

	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	560.0
TEMP, DEG K	3750.3	3252.5	2777.8	2513.0	1875.7	1647.6	1497.3	1182.6	925.2	718.0	554.2	426.8	3433.2
ENTHALPY (-)	22.30	50.00	74.99	95.21	111.77	119.87	125.07	135.63	143.93	150.40	155.41	159.27	40.77
X BAR	4.493	4.413	4.357	4.330	4.323	4.323	4.323	4.323	4.323	4.322	4.322	4.322	4.440
N	4.493	4.413	4.357	4.330	4.323	4.323	4.323	4.323	4.323	4.322	4.322	4.322	4.440
CP	.7551	.6540	.5084	.4098	.3623	.3493	.3425	.3285	.3166	.3083	.3037	.3047	.6800
IMPELL OPT	157.48	214.10	251.85	278.98	291.34	299.00	313.99	325.29	333.83	340.29	345.19	348.77	126.77
IMPELL VAC	236.27	262.97	286.23	304.12	312.48	317.72	328.06	335.92	341.86	346.38	349.81	350.73	230.73
EPSILON	1.066	1.661	2.936	5.390	7.748	10.082	12.046	13.612	14.824	15.624	16.059	16.189	1.000

	COMPOSITION SHIFTING (MOL/100 GM)												
28.92 CL	.1658	.0966	.0403	.0096	.0010	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.1216
-13.50 CL-F	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-38.87 CL-F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-21.97 CL-F	.5901	.6595	.7166	.7475	.7561	.7569	.7571	.7571	.7571	.7571	.7571	.7571	.6347
.00 CL2	.0006	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004
18.86 F	.0172	.0051	.0008	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0087
-64.50 F-H	2.2520	2.2662	2.2705	2.2713	2.2713	2.2713	2.2713	2.2713	2.2713	2.2713	2.2713	2.2713	2.2625
58.60 F-H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.1566	.0789	.0289	.0062	.0006	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.1048
79.20 F-H	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
.00 F2	.3727	.3696	.3642	.3597	.3582	.3580	.3580	.3580	.3580	.3580	.3579	.3579	.3571
40.30 F2-H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3-H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
.00 N2	.9359	.9361	.9361	.9361	.9361	.9361	.9361	.9361	.9361	.9361	.9361	.9361	.9360

PRESSURE PROFILE DATA
 SYSTEM LIQUID PROPELLANT PC 1000 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. C/D
 DEG K GM/CC (KCAL/FORM.WT.)
 298 CL=F3 1.88 -44.35 75.
 298 N2=H4 1.004 +12.05 25.

BULK DENSITY = 1.543 GM/CC
 MIXTURE RATIO = 3.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 232.72 EU/100GMS

CHAMBER

THRUST

	IC00	396.1	158.5	63.10	25.12	14.70	10.00	3.991	1.585	.631	.251	.100	542.1
PRESSURE, PSIA	1000	396.1	158.5	63.10	25.12	14.70	10.00	3.991	1.585	.631	.251	.100	542.1
TEMP, DEG K	3928.0	3159.6	2529.3	2012.7	1589.7	1380.0	1244.3	965.2	742.8	568.7	434.3	331.7	3400.4
ENTHALPY (-)	26.58	53.86	75.77	93.25	107.12	113.79	118.03	126.53	133.09	138.14	141.97	144.92	45.37
CP	.3583	.3515	.3433	.3330	.3214	.3148	.3095	.2992	.2912	.2818	.2761	.2849	.3537
IMPELL OPT	154.07	206.87	240.84	264.70	275.45	282.06	294.87	304.41	311.53	316.67	320.86	327.87	127.87
IMPELL VAC	228.94	251.50	271.35	286.63	293.74	298.16	306.82	313.31	318.19	321.87	324.64	324.95	
EPSILON	1.050	1.573	2.700	4.873	6.949	8.992	16.759	31.382	58.980	111.220	210.713	1.000	

	IC00	396.1	158.5	63.10	25.12	14.70	10.00	3.991	1.585	.631	.251	.100	561.8
PRESSURE, PSIA	1000	396.1	158.5	63.10	25.12	14.70	10.00	3.991	1.585	.631	.251	.100	561.8
TEMP, DEG K	3928.0	3433.2	2965.9	2508.1	2050.4	1818.7	1673.6	1368.8	1092.5	854.4	662.2	511.0	3614.4
ENTHALPY (-)	26.58	54.71	78.74	99.05	115.82	124.08	129.42	140.49	149.41	156.44	161.92	166.15	44.70
X BAR	4.223	4.139	4.074	4.033	4.019	4.008	3.997	3.973	3.964	3.963	3.963	3.963	4.168
N	4.223	4.139	4.074	4.033	4.019	4.008	3.997	3.973	3.964	3.963	3.963	3.963	4.168
CP	.7764	.6599	.5435	.4184	.3582	.3792	.3897	.3532	.3058	.2884	.2816	.2783	.7035
IMPELL OPT	156.45	213.03	251.09	278.63	291.24	299.11	314.80	326.89	336.12	343.13	348.45	357.57	
IMPELL VAC	234.98	262.07	285.92	304.19	312.87	318.45	329.73	338.34	344.83	349.74	353.48	359.30	
EPSILON	1.068	1.676	2.990	5.512	7.974	10.473	20.317	39.138	74.751	142.558	272.103	1.000	

	IC00	396.1	158.5	63.10	25.12	14.70	10.00	3.991	1.585	.631	.251	.100	3050
28.92 CL	.3471	.2771	.1992	.1375	.1115	.0906	.0686	.0199	.0021	.0001	.0000	.0000	.3050
-13.50 CL=F	.0006	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
-38.87 CL=F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-21.97 CL=F	.4598	.5309	.6093	.6704	.6865	.6868	.6868	.6868	.6868	.6868	.6868	.6868	.5027
.CC CL2	.0018	.0015	.0013	.0016	.0066	.0168	.0279	.0523	.0612	.0622	.0622	.0622	.0016
18.86 F	.0664	.0254	.0075	.0017	.0033	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0374
-64.50 F=F	2.3666	2.4080	2.4260	2.4318	2.4332	2.4334	2.4335	2.4336	2.4336	2.4336	2.4336	2.4336	2.3958
58.60 F=F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.CC F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.1065	.0504	.0161	.0022	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0690
79.20 F=F	.0021	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.CC F2	.0936	.0655	.0345	.0079	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0764
40.30 F=F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F=F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
.CC A2	.7799	.7800	.7801	.7801	.7801	.7801	.7801	.7801	.7801	.7801	.7801	.7801	.7800

SYSTEM LIQUID BIPROPELLANT										PC 1000 PSIA									
COMPONENT										DENSITY									
REF. FORMULA										HEAT FORM									
CEG K										G/CC									
298 CL+FS										1.000									
298 N2+H2										1.000									
										+12.05									
										75.									
										75.									

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 298 CL*F3 1.880 -44.35 80.
 298 N2*H4 1.004 +12.05 20.

BULK DENSITY = 1.601 GM/CC
 MIXTURE RATIO = 4.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 217.4C EU/100GMS

CHAMBER													THROAT
FROZEN EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	537.7
TEMP, DEG K	3588.8	2848.4	2244.5	1762.9	1370.8	1179.2	1056.6	808.3	615.3	467.1	354.5	267.5	5073.1
ENTHALPY (-)	30.85	54.71	73.59	88.46	100.06	105.58	109.05	115.95	121.22	125.23	128.25	130.58	47.52
CP	.3753	.3187	.3106	.3009	.2909	.2850	.2815	.2747	.2713	.2696	.2683	.2670	.3209
IMPUL OPT		144.05	192.82	223.85	245.37	254.96	260.81	272.08	280.38	286.53	291.08	294.54	120.41
IMPUL VAC		213.55	233.81	251.53	265.01	271.21	275.05	282.52	288.09	292.25	295.36	297.74	210.12
EPSILON		1.046	1.550	2.629	4.685	6.630	8.534	15.719	29.168	54.424	102.146	191.312	1.000
SHIFTING EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	549.4
TEMP, DEG K	3588.8	2981.6	2515.6	2169.4	1896.7	1757.3	1662.2	1439.4	1204.9	964.1	754.5	587.0	3179.2
ENTHALPY (-)	30.85	55.15	75.19	91.98	106.25	113.58	118.45	128.90	137.69	144.84	150.48	154.88	47.17
X HAK	4.066	4.031	3.970	3.886	3.795	3.745	3.712	3.648	3.612	3.603	3.603	3.603	4.045
N	4.066	4.031	3.970	3.886	3.795	3.745	3.712	3.648	3.612	3.603	3.603	3.603	4.045
CP	.4342	.4558	.5632	.6687	.6960	.6650	.6231	.4790	.3381	.2772	.2650	.2610	.4354
IMPUL OPT		145.31	196.39	230.60	256.10	268.26	276.05	292.04	304.86	314.89	322.60	328.48	119.15
IMPUL VAC		216.82	240.36	262.21	280.39	289.47	295.38	307.59	317.20	324.43	329.88	334.04	212.47
EPSILON		1.057	1.633	2.948	5.694	8.496	11.375	22.983	45.845	88.986	170.736	327.693	1.000
COMPOSITION SHIFTING (MCL/100 GM)													
28.92 CL	.6703	.6831	.6216	.4958	.3447	.2581	.1997	.0837	.0180	.0013	.0000	.0000	.6857
-13.50 CL*F	.0099	.0180	.0327	.0510	.0690	.0782	.0840	.0941	.0986	.0995	.0995	.0995	.0144
-38.87 CL*F3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-21.97 CL*F	.1552	.0918	.0466	.0214	.0089	.0050	.0032	.0009	.0001	.0000	.0000	.0000	.1127
.00 CL2	.0149	.0361	.0822	.1486	.2213	.2620	.2892	.3433	.3742	.3822	.3828	.3829	.0263
18.86 F	.2510	.1737	.1134	.0699	.0395	.0263	.0188	.0063	.0010	.0001	.0000	.0000	.1988
-64.50 F*H	2.3348	2.4041	2.4496	2.4747	2.4874	2.4912	2.4931	2.4954	2.4961	2.4962	2.4963	2.4963	2.3825
58.60 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.0048	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0009
79.20 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0007	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
40.30 F2*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
115.00 N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	.6240	.6241	.6241	.6241	.6241	.6241	.6241	.6241	.6241	.6241	.6241	.6241	.6241

EPILESEN	SHIPWILL EXPANSION													
	P/CPP	P PSIA	TEMP	ENTHALPY	CP CAL/G	I NPT	DEL VAC	FL VAC	I SVA	I AT	I VAC	CF SEA	CF VAC	
	10000	10000	DEG F	KCAL/1000G	GR DEG				10000	50000		LVL	LVL	
1.CCDD	1.8020	549.371	319.2	-87.17	.435	119.1	93.5	.170	210.0	210.7	212.2	212.5	1.251	1.236
2.CCDD	1.9551	1051.703	2369.6	-81.96	.606	211.4	37.5	.358	243.6	256.2	248.3	248.9	1.434	1.465
5.CCDD	16.229	61.392	2161.0	-92.41	.671	251.4	31.3	.511	255.3	257.5	261.9	262.6	1.503	1.587
6.CCDD	25.215	15.659	2052.6	-90.74	.694	256.6	27.6	.497	261.0	268.1	270.1	271.3	1.533	1.599
7.CCDD	34.420	20.394	1944.6	-103.69	.694	255.1	26.8	.494	260.5	268.1	275.7	277.2	1.557	1.627
8.CCDD	42.806	23.561	1877.6	-107.25	.694	257.8	23.8	1.021	266.7	271.2	279.9	281.7	1.570	1.658
9.CCDD	52.750	18.943	1825.1	-110.13	.694	262.6	22.6	1.194	267.1	273.0	283.2	285.2	1.576	1.679
10.CCDD	62.949	15.866	1777.7	-112.53	.687	266.6	21.6	1.162	268.2	274.2	285.9	288.2	1.579	1.697
11.CCDD	73.500	13.500	1727.7	-114.65	.683	272.7	20.6	1.162	275.0	288.1	295.0	297.0	1.584	1.704
12.CCDD	85.959	10.443	1672.9	-117.91	.629	275.2	19.5	1.870	275.5	291.5	296.7	297.7	1.735	1.755
13.CCDD	107.444	9.307	1645.1	-119.31	.614	271.4	19.0	2.042	274.0	292.9	296.4	296.4	1.785	1.805
14.CCDD	119.664	8.677	1615.7	-120.57	.594	267.2	18.5	2.218	270.1	291.2	294.1	294.1	1.835	1.855
15.CCDD	132.211	7.564	1594.2	-121.72	.585	261.2	18.2	2.395	270.2	295.2	297.6	297.6	1.885	1.905
16.CCDD	145.626	6.895	1575.6	-122.57	.571	268.8	17.7	2.571	270.1	296.1	300.5	300.5	1.769	1.769
17.CCDD	158.502	6.327	1554.2	-123.75	.558	268.3	17.4	2.747	270.0	301.6	301.6	301.6	1.776	1.776
18.CCDD	171.234	5.846	1535.1	-124.63	.545	285.6	17.1	2.921	270.7	302.7	302.7	302.7	1.782	1.782
19.CCDD	184.000	5.414	1521.7	-125.38	.531	285.8	16.8	3.096	270.8	303.8	303.8	303.8	1.788	1.788
20.CCDD	197.888	5.053	1500.0	-126.74	.521	289.1	16.5	3.262	270.0	304.5	304.5	304.5	1.795	1.795
21.CCDD	211.274	4.733	1481.6	-126.96	.510	289.2	16.2	3.428	270.5	305.4	305.4	305.4	1.798	1.798
22.CCDD	224.670	4.451	1460.8	-127.45	.499	290.2	16.0	3.591	270.0	306.2	306.2	306.2	1.802	1.802
23.CCDD	238.053	4.201	1453.4	-128.29	.489	292.1	15.8	3.751	270.5	306.9	306.9	306.9	1.807	1.807
24.CCDD	251.449	4.000	1444.9	-128.91	.479	292.1	15.5	3.916	270.0	307.9	307.9	307.9	1.812	1.812
25.CCDD	266.634	3.750	1425.1	-129.49	.469	292.9	15.3	4.087	270.1	308.3	308.3	308.3	1.815	1.815
26.CCDD	282.088	3.545	1411.7	-130.04	.460	293.7	15.1	4.268	270.6	308.9	308.9	308.9	1.818	1.818
27.CCDD	297.779	3.358	1398.7	-130.57	.451	294.5	14.9	4.449	270.9	309.5	309.5	309.5	1.822	1.822
28.CCDD	313.664	3.155	1385.8	-131.09	.441	295.3	14.7	4.630	271.2	310.1	310.1	310.1	1.827	1.827
29.CCDD	329.793	2.932	1373.9	-131.55	.435	296.0	14.6	4.810	271.4	310.6	310.6	310.6	1.828	1.828
30.CCDD	346.072	2.690	1362.2	-132.01	.428	296.7	14.4	4.990	271.6	311.1	311.1	311.1	1.831	1.831
31.CCDD	362.506	2.759	1350.8	-132.46	.420	297.3	14.3	5.169	271.9	311.6	311.6	311.6	1.834	1.834
32.CCDD	379.075	2.638	1339.7	-132.88	.413	298.1	14.1	5.348	272.1	312.0	312.0	312.0	1.837	1.837
33.CCDD	395.749	2.520	1328.9	-133.28	.406	298.8	14.0	5.527	272.3	312.5	312.5	312.5	1.840	1.840
34.CCDD	412.541	2.404	1318.5	-133.68	.400	299.1	13.8	5.700	272.5	313.0	313.0	313.0	1.842	1.842
35.CCDD	429.433	2.329	1308.3	-134.05	.394	299.6	13.7	5.874	272.8	313.5	313.5	313.5	1.844	1.844
36.CCDD	446.330	2.260	1298.4	-134.42	.388	300.2	13.5	6.047	273.0	313.7	313.7	313.7	1.847	1.847
37.CCDD	463.326	2.158	1288.7	-134.77	.382	300.7	13.4	6.219	273.2	314.0	314.0	314.0	1.849	1.849
38.CCDD	480.318	2.082	1279.4	-135.11	.377	301.2	13.3	6.386	273.4	314.5	314.5	314.5	1.851	1.851
39.CCDD	497.355	2.011	1270.2	-135.44	.372	301.6	13.2	6.553	273.6	314.8	314.8	314.8	1.853	1.853
40.CCDD	514.443	1.944	1261.2	-135.75	.367	302.1	13.1	6.717	273.8	315.1	315.1	315.1	1.855	1.855
41.CCDD	531.461	1.882	1252.5	-136.06	.362	302.5	12.9	6.880	274.0	315.5	315.5	315.5	1.857	1.857
42.CCDD	548.519	1.826	1243.9	-136.36	.358	302.9	12.8	7.043	274.2	315.8	315.8	315.8	1.859	1.859
43.CCDD	565.559	1.768	1235.5	-136.65	.353	303.4	12.7	7.198	274.4	316.0	316.0	316.0	1.861	1.861
44.CCDD	582.592	1.710	1227.3	-136.93	.349	303.8	12.6	7.355	274.6	316.4	316.4	316.4	1.863	1.863
45.CCDD	599.609	1.668	1219.1	-137.20	.345	304.2	12.5	7.509	274.8	316.7	316.7	316.7	1.864	1.864
46.CCDD	616.615	1.631	1211.0	-137.46	.341	304.6	12.4	7.661	275.0	317.0	317.0	317.0	1.866	1.866
47.CCDD	633.623	1.577	1203.6	-137.73	.338	304.9	12.3	7.815	275.2	317.2	317.2	317.2	1.868	1.868
48.CCDD	650.630	1.530	1195.8	-137.98	.335	305.3	12.2	7.994	275.4	317.5	317.5	317.5	1.869	1.869
49.CCDD	667.637	1.485	1188.2	-138.22	.332	305.6	12.1	8.172	275.6	317.8	317.8	317.8	1.871	1.871
50.CCDD	684.644	1.442	1180.6	-138.46	.329	306.0	12.0	8.351	275.8	318.0	318.0	318.0	1.872	1.872
51.CCDD	701.651	1.400	1173.0	-138.69	.326	306.3	11.9	8.530	276.0	318.3	318.3	318.3	1.874	1.874
52.CCDD	718.658	1.358	1165.3	-138.91	.323	306.6	11.8	8.708	276.2	318.6	318.6	318.6	1.876	1.876
53.CCDD	735.665	1.316	1157.5	-139.13	.320	306.9	11.7	8.886	276.4	318.9	318.9	318.9	1.878	1.878
54.CCDD	752.672	1.274	1149.7	-139.35	.317	307.2	11.6	9.064	276.6	319.2	319.2	319.2	1.880	1.880
55.CCDD	769.679	1.232	1141.9	-139.56	.314	307.5	11.5	9.242	276.8	319.5	319.5	319.5	1.882	1.882
56.CCDD	786.686	1.190	1134.1	-139.77	.311	307.8	11.4	9.420	277.0	319.8	319.8	319.8	1.884	1.884
57.CCDD	803.693	1.148	1126.3	-139.97	.308	308.1	11.3	9.598	277.2	320.1	320.1	320.1	1.886	1.886
58.CCDD	820.700	1.106	1118.5	-140.17	.305	308.4	11.2	9.776	277.4	320.4	320.4	320.4	1.888	1.888
59.CCDD	837.707	1.064	1110.7	-140.37	.302	308.7	11.1	9.954	277.6	320.7	320.7	320.7	1.890	1.890
60.CCDD	854.714	1.022	1102.9	-140.57	.300	309.0	11.0	10.132	277.8	321.0	321.0	321.0	1.892	1.892
61.CCDD	871.721	978.000	1095.1	-140.76	.297	309.3	10.9	10.310	278.0	321.3	321.3	321.3	1.894	1.894
62.CCDD	888.728	978.000	1087.3	-140.95	.294	309.6	10.8	10.488	278.2	321.6	321.6	321.6	1.896	1.896
63.CCDD	905.735	978.000	1079.5	-141.14	.291	309.9	10.7	10.666	278.4	321.9	321.9	321.9	1.898	1.898
64.CCDD	922.742	978.000	1071.7	-141.33	.288	310.2	10.6	10.844	278.6	322.2	322.2	322.2	1.900	1.900
65.CCDD	939.749	978.000	1063.9	-141.52	.285	310.5	10.5	11.022	278.8	322.5	322.5	322.5	1.902	1.902
66.CCDD	956.756	978.000	1056.1	-141.71	.282	310.8	10.4	11.200	279.0	322.8	322.8	322.8	1.904	1.904
67.CCDD	973.763	978.000	1048.3	-141.90	.279	311.1	10.3	11.378	279.2	323.1	323.1	323.1	1.906	1.906
68.CCDD	990.770	978.000	1040.5	-142.09	.276	311.4	10.2	11.556	279.4	323.4	323.4	323.4	1.908	1.908
69.CCDD	1007.777	978.000	1032.7	-142.28	.273	311.7	10.1	11.734	279.6	323.7	323.7	323.7	1.910	1.910
70.CCDD	1024.784	978.000	1024.9	-142.47	.270	312.0	10.0	11.912	279.8	324.0	324.0	324.0	1.912	1.912
71.CCDD	1041.791	978.000	1017.1	-142.66	.267	312.3	9.9	12.090	280.0	324.3	324.3	324.3	1.914	1.914
72.CCDD	1058.798	978.000	1009.3	-142.85	.264	312.6	9.8	12.268	280.2	324.6	324.6	324.6	1.916	1.916
73.CCDD	1075.805	978.000	1001.5	-143.04	.261	312.9	9.7	12.446	280.4	324.9	324.9	324.9	1.918	1.918
74.CCDD	1092.812	978.000	993.7	-143.23	.258	313.2	9.6	12.624	280.6	325.2	325.2	325.2	1.920	1.920
75.CCDD	1109.819	978.000	985.9	-143.42	.255	313.5	9.5	12.802	280.8	325.5	325.5	325.5	1.922	1.922
76.CCDD	1126.826	978.000	978.1	-143.61	.252	313.8	9.4	12.980	281.0	325.8	325.8	325.8	1.924	1.924
77.CCDD	1143.833	978.000	970.3	-143.80	.249	314.1	9.3	13.158	281.2	326.1	326.1	326.1	1.926	1.926
78.CCDD	1160.840	978.000	962.5	-143.99	.246	314.4	9.2	13.336	281.4	326.4	326.4	326.4	1.928	1.928
79.CCDD	1177.847	978.000	954.7	-144.18	.243	314.7	9.1	13.514	281.6	326.7	326.7	326.7	1.930	1.930
80.CCDD	1194.854	978.000	946.9	-144.37	.240	315.0	9.0	13.692	281.8	327.0	327.0	327.0	1.932	1.932
81.CCDD	1211.861													

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. C/O
 LEG K GM/CC (KCAL/FORM.WT.)
 298 CL*F3 1.00 -44.35 55.
 298 N2*H4 1.004 +12.05 45.

BULK DENSITY = 1.350 GM/CC
 MIXTURE RATIO = 1.222 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 292.76 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	163.3
TEMP, DEG K	2935.0	2459.4	2017.6	1659.1	1421.4	1355.2	1098.8	895.0	708.8	565.3	449.9	358.1	2551.4
ENTHALPY (-)	9.46	32.73	52.02	67.93	78.17	80.97	91.59	100.17	107.06	112.57	116.96	120.44	27.52
CP	.4747	.4637	.4505	.4363	.4247	.4213	.4072	.3954	.3870	.3817	.3794	.3777	.4663
IMPUL OPT		142.26	192.41	225.53	244.48	249.42	267.29	280.91	291.38	299.50	305.81	310.71	125.33
IMPUL VAC		223.12	241.86	260.22	271.90	275.04	286.68	295.77	302.85	308.40	312.75	316.15	221.33
EPSILON		1.021	1.391	2.173	3.174	3.573	6.021	10.276	17.669	30.535	52.944	92.455	1.000
	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	163.3
TEMP, DEG K	2935.0	2517.3	2115.6	1751.1	1504.7	1435.8	1168.2	944.0	758.1	606.3	484.2	408.3	2623.0
ENTHALPY (-)	9.46	33.03	52.95	69.54	80.26	83.20	94.36	103.41	110.70	116.54	121.21	124.96	27.38
X BAR	5.455	5.419	5.405	5.402	5.402	5.402	5.402	5.402	5.402	5.402	5.399	5.345	5.425
N	5.455	5.419	5.405	5.402	5.402	5.402	5.402	5.402	5.402	5.402	5.399	5.360	5.425
CP	.6582	.5435	.4743	.4426	.4266	.4245	.4096	.3971	.3878	.3826	.3865	18.1910	.5689
IMPUL OPT		143.19	194.51	228.62	248.18	253.28	271.77	285.88	296.77	305.21	311.79	316.98	124.83
IMPUL VAC		225.55	245.34	264.39	276.49	279.75	291.84	301.30	308.70	314.48	319.04	322.93	223.39
EPSILON		1.025	1.409	2.208	3.231	3.640	6.146	10.513	18.114	31.366	54.576	94.815	1.000
	COMPOSITION SHIFTING (MOL/100 GM)												
28.92 CL	.0211	.0070	.0014	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0097
-13.5C CL*F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-38.87 CL*F3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-21.97 CL*H	.5737	.5879	.5935	.5947	.5949	.5949	.5949	.5949	.5949	.5949	.5949	.5805	.5852
.00 CL2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.0006	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-64.5C F*H	1.7840	1.7845	1.7846	1.7846	1.7846	1.7846	1.7846	1.7846	1.7846	1.7846	1.7846	1.7846	1.7845
58.6C F*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.1C H	.0035	.0263	.0050	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0364
79.2C F*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	1.5676	1.6089	1.6167	1.6183	1.6185	1.6185	1.6185	1.6185	1.6183	1.6177	1.6136	1.5762	1.6049
40.3C H2*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 H3*N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0001	.0002	.0006	.0033	.0139	.0000
113.0C N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	1.4041	1.4041	1.4041	1.4041	1.4041	1.4041	1.4041	1.4041	1.4041	1.4039	1.4025	1.3900	1.4041
-75.38 CL*H4*N/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0143	.0000

SYSTEM LIQUID BIPROPELLANT										PC 300 PSIA		DENSITY		HEAT FORM		WT. 6/8	
COMPONENT										REF FORMULA		GN/CC		(KCAL/POUN.MT.)		SS.	
										298 CL=F3		1.004		-44.35		45.	
										298 N2=H2		1.004		+12.05			
										FROZEN EXPANSION		C STAR = 5475.7 FT/SEC					
										CP CAL/ I OPT DELVAC DELVAC		I SEA		I AT		I VAC	
										GP DEG		LVL		10000		CF SEA	
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/ I OPT DELVAC DELVAC	I SEA	I AT	I VAC	CF SEA	CF VAC	LVL	10000	50000	I VAC	CF SEA	CF VAC	LVL
1.000	1.000	300.000	2935.0	-9.48	.475	125.3	96.0	.588	212.7	215.3	220.3	221.3	1.206	1.255			
2.000	1.837	163.317	2550.4	-27.32	.460	221.3	36.0	1.210	239.6	244.9	255.3	257.4	1.359	1.459			
3.000	10.082	29.757	1712.7	-65.40	.439	242.0	20.3	1.767	244.4	252.2	267.3	270.3	1.586	1.533			
4.000	18.719	16.217	1454.0	-76.78	.426	253.8	24.1	2.357									
5.000	29.384	10.210	1295.1	-83.46	.418	261.6	21.3	2.957									
6.000	41.572	7.216	1186.0	-88.70	.412	267.2	19.4	3.578									
7.000	54.483	5.505	1100.4	-91.93	.407	271.5	17.9	4.149									
8.000	69.341	4.324	1034.0	-94.22	.404	275.0	16.8	4.760									
9.000	85.267	3.527	979.6	-96.41	.401	277.9	15.8	5.365									
10.000	101.216	2.964	933.9	-98.23	.398	280.6	15.1	5.895									
11.000	117.487	2.553	894.8	-99.79	.396	282.4	14.4	6.489									
12.000	135.462	2.215	860.7	-101.13	.394	284.2	13.8	7.109									
13.000	154.774	1.938	830.7	-102.31	.393	285.8	13.3	7.722									
14.000	174.717	1.717	803.9	-103.36	.391	287.2	12.8	8.324									
15.000	195.111	1.538	779.8	-104.30	.390	288.5	12.4	8.911									
16.000	215.801	1.390	758.1	-105.15	.389	289.7	12.0	9.479									
17.000	236.660	1.268	738.3	-105.92	.388	290.7	11.7	10.029									
18.000	257.605	1.165	720.1	-106.62	.387	291.7	11.4	10.591									
19.000	278.426	1.074	703.3	-107.27	.387	292.6	11.1	11.170									
20.000	300.000	.989	687.8	-107.87	.386	293.4	10.8	11.769									
21.000	322.900	.915	673.4	-108.43	.386	294.2	10.6	12.385									
22.000	352.947	.850	660.0	-108.94	.385	294.9	10.4	13.004									
23.000	378.432	.793	647.5	-109.43	.385	295.6	10.2	13.645									
24.000	404.261	.742	635.7	-109.90	.384	296.3	10.1	14.304									
25.000	430.424	.697	624.6	-110.35	.384	296.9	9.9	14.985									
26.000	456.768	.657	614.1	-110.78	.383	297.5	9.8	15.685									
27.000	483.340	.621	604.2	-111.18	.383	297.9	9.6	16.408									
28.000	510.026	.588	594.9	-111.54	.383	298.2	9.4	17.154									
29.000	536.764	.559	586.0	-111.78	.382	298.4	9.3	17.924									
30.000	563.629	.532	577.6	-112.10	.382	298.6	9.1	18.723									
31.000	590.509	.508	569.5	-112.41	.382	299.3	9.0	19.544									
32.000	618.853	.485	561.8	-112.71	.382	299.7	8.8	20.391									
33.000	648.201	.462	554.5	-112.99	.381	300.0	8.7	21.264									
34.000	678.651	.441	547.4	-113.25	.381	300.5	8.6	22.163									
35.000	711.233	.422	540.7	-113.51	.381	300.9	8.5	23.091									
36.000	744.851	.404	534.2	-113.76	.381	301.2	8.4	24.049									
37.000	778.629	.387	528.0	-113.99	.381	301.6	8.3	25.132									
38.000	812.534	.372	522.1	-114.22	.381	301.9	8.2	26.240									
39.000	846.569	.357	516.3	-114.44	.381	302.2	8.1	27.374									
40.000	872.569	.344	510.8	-114.65	.380	302.5	8.0	28.534									
41.000	900.509	.331	505.5	-114.85	.380	302.8	7.9	29.724									
42.000	928.426	.319	500.3	-115.05	.380	303.1	7.8	30.944									
43.000	956.768	.308	495.4	-115.24	.380	303.3	7.7	32.194									
44.000	985.424	.298	490.6	-115.42	.380	303.6	7.6	33.474									
45.000	1014.261	.288	486.9	-115.60	.380	303.9	7.5	34.784									
46.000	1043.261	.279	483.4	-115.77	.380	304.1	7.5	36.124									
47.000	1072.426	.271	479.0	-115.93	.380	304.3	7.4	37.494									
48.000	1101.761	.263	474.8	-116.09	.380	304.6	7.3	38.894									
49.000	1131.261	.255	469.7	-116.25	.380	304.8	7.3	40.324									
50.000	1160.901	.248	464.7	-116.40	.380	305.0	7.2	41.784									
51.000	1190.651	.241	460.0	-116.55	.380	305.2	7.1	43.274									
52.000	1220.426	.234	455.4	-116.70	.380	305.4	7.1	44.794									
53.000	1250.261	.228	450.9	-116.85	.380	305.6	7.0	46.344									

SHIFTING EXPANSION																
C STAR = 5750.2 FT/SEC																
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/ I OPT DELVAC DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC	LVL	10000	50000	I VAC	CF SEA
			DEG K	KCAL/1000G	GN GRAD											
1.000	1.015	165.262	2813.0	-27.36	.589	124.8	98.6	.596	214.6	217.3	222.4	223.4	1.249	1.200		
2.000	0.938	30.493	1808.9	-66.59	.446	223.1	37.5	1.230	242.7	248.2	258.7	260.8	1.357	1.458		
3.000	18.217	16.448	1549.4	-78.35	.431	244.8	29.5	1.794	248.0	255.9	271.1	274.4	1.586	1.533		
4.000	20.529	10.515	1383.4	-85.42	.421	257.1	25.1	2.390		257.6	276.1	278.4		1.577		
5.000	30.343	7.434	1267.1	-90.29	.415	265.2	22.3	3.000			282.4	284.7		1.577		
6.000	42.905	5.671	1179.4	-93.91	.410	271.0	20.3	3.583			285.2	291.4		1.629		
7.000	57.105	4.471	1109.6	-96.75	.404	275.6	18.8	4.205			287.2	294.6		1.695		
8.000	72.330	3.644	1052.4	-99.07	.403	278.2	17.6	4.828			288.6	296.9		1.659		
9.000	88.011	3.081	1004.3	-101.01	.400	282.2	16.6	5.427			289.4	298.4		1.677		
10.000	103.842	2.635	963.0	-102.65	.398	284.7	15.8	6.003			290.3	300.5		1.680		
11.000	120.742	2.295	927.0	-104.08	.396	286.9	15.1	6.576			290.8	302.0		1.688		
12.000	138.742	2.009	895.2	-105.34	.395	288.8	14.5	7.205			291.0	303.3		1.695		
13.000	158.054	1.760	866.8	-106.46	.393	290.5	13.9	7.829			291.1	304.4		1.700		
14.000	178.100	1.593	841.3	-107.46	.392	292.0	13.5	8.444				305.3		1.712		
15.000	199.460	1.440	818.2	-108.36	.391	293.3	13.0	9.055				306.3		1.712		
16.000	221.957	1.312	797.2	-109.18	.390	294.5	12.6	9.629				307.2		1.717		
17.000	245.619	1.205	777.9	-109.93	.389	295.6	12.3	10.194				307.9		1.721		
18.000	269.315	1.114	760.1	-110.62	.388	296.7	12.0	10.741				308.4		1.725		
19.000	293.036	1.027	743.6	-111.26	.387	297.6	11.7	11.358				309.3		1.729		
20.000	315.405	.951	728.2	-111.86	.386	298.5	11.4	11.986				309.9		1.732		
21.000	339.492	.883	713.9	-112.41	.386	299.3	11.1	12.613				310.4		1.735		
22.000	364.227	.824	700.5	-112.93	.385	300.0	10.9	13.237				310.9		1.738		
23.000	389.619	.774	688.0	-113.41	.385	300.7	10.7	13.856				311.4		1.741		
24.000	416.364	.724	676.2	-113.86	.384	301.4	10.5	14.469				311.8		1.743		
25.000	443.838	.682	665.0	-114.29	.384	302.0	10.3	15.075				312.3		1.745		
26.000	462.957	.644	654.5	-114.70	.383	302.6	10.1	15.672				312.7		1.748		
27.000	483.323	.611	644.3	-115.08	.383	303.1	9.9	16.258				313.1		1.750		
28.000	504.245	.580	635.5	-115.44	.383	303.6	9.8	16.836				313.6		1.752		
29.000	526.291	.552	626.0	-115.79	.383	304.1	9.6	17.404				313.7		1.754		
30.000	549.288	.527	617.4	-116.12	.383	304.6	9.5	17.961				314.1		1.755		
31.000	573.373	.504	609.2	-116.43	.383	305.0	9.3	18.508				314.9		1.760		
32.000	598.452	.483	601.2	-116.73	.383	305.4	9.2	19.045				315.7		1.767		
33.000	625.087	.459	593.5	-117.02	.383	305.9	9.1	19.575				316.9		1.770		
34.000	653.072	.439	586.1	-117.30	.383	306.3	8.9	20.339				315.2		1.762		
35.000	671.749	.420	579.1	-117.56	.383	306.7	8.8	20.974				315.5		1.763		
36.000	690.009	.403	571.8	-117.81	.383	307.0	8.7	21.588				315.8		1.765		
37.000	707.829	.387	564.8	-118.06	.383	307.4	8.6	22.221				316.0		1.766		
38.000	826.668	.372	559.5	-118.29	.383	307.7	8.5	22.842				316.2		1.767		
39.000	830.581	.358	553.5	-118.52	.383	308.0	8.4	23.460				316.4		1.769		
40.000	870.537	.345	547.8	-118.74	.383	308.3	8.3	24.077				316.6		1.770		
41.000	902.406	.332	542.5	-118.95	.383	308.6	8.2	24.689				316.8		1.771		
42.000	925.054	.321	536.9	-119.15	.383	308.9	8.1	25.299				317.0		1.772		
43.000	947.556	.310	531.7	-119.35	.383	309.2	8.0	25.904				317.2		1.773		
44.000	1000.183	.300	526.8	-119.54	.383	309.4	8.0	26.505				317.4		1.774		
45.000	1032.969	.290	522.0	-119.72	.383	309.7	7.9	27.102				317.6		1.775		
46.000	1065.799	.282	517.4	-119.90	.383	310.0	7.8	27.694				317.7		1.776		
47.000	1098.556	.273	513.0	-120.07	.383	310.2	7.7	28.280				317.9		1.777		
48.000	1131.334	.265	508.7	-120.23	.383	310.4	7.7	28.861				318.1		1.778		
49.000	1164.223	.258	504.6	-120.39	.383	310.7	7.6	29.433				318.2		1.779		
50.000	1197.202	.251	500.6	-120.54	.383	310.9	7.6	30.000				318.4		1.780		
3.231	20.414	14.696	1504.7	-80.26	.229	248.2	28.3	1.927	248.2	256.7	273.2	270.5	1.387	1.585		

PRESSURE PROFILE DATA
 SYSTEM LIQUID NITROPELLANT PC 300 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 CEG K CM/CC (KCAL/FORM.WT.)
 298 CL*F3 1.880 -44.35 65.
 298 N2*H4 1.004 +12.05 35.

BULK DENSITY = 1.440 GM/CC
 MIXTURE RATIO = 1.857 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 269.49 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	163.3
TEMP, DEG K	3391.2	2816.2	2329.1	1916.6	1643.8	1567.9	1273.7	1027.4	823.2	656.3	521.6	415.8	2945.7
ENTHALPY (-)	18.02	41.82	61.56	77.85	88.33	91.20	102.10	110.92	118.01	123.68	128.19	131.77	36.51
CP	.4178	.4097	.4000	.3891	.3795	.3768	.3656	.3523	.3428	.3367	.3332	.3317	.4117
IMPLL OPT	143.91	194.62	228.13	247.32	252.32	270.46	284.28	294.93	303.18	309.59	314.58	316.81	126.81
IMPLL VAC	225.69	244.63	263.24	275.09	278.29	290.14	299.38	306.60	312.23	316.63	320.08	323.88	
EPSILON	1.021	1.391	2.174	3.179	3.581	6.044	10.329	17.766	30.687	53.163	92.475	1.000	
	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	168.1
TEMP, DEG K	3391.2	2998.2	2610.5	2272.3	1934.7	1851.5	1522.0	1241.6	1005.3	808.5	647.0	516.2	3105.7
ENTHALPY (-)	18.02	42.39	63.53	81.59	93.48	96.76	109.30	119.57	127.91	134.64	140.05	144.36	35.99
X BAR	4.834	4.761	4.713	4.690	4.684	4.683	4.682	4.682	4.682	4.682	4.682	4.682	4.779
A	4.834	4.761	4.713	4.690	4.684	4.683	4.682	4.682	4.682	4.682	4.682	4.682	4.779
CP	.8105	.6725	.5376	.4396	.4001	.3925	.3726	.3585	.3471	.3376	.3317	.3288	.7120
IMPLL OPT	145.61	198.97	235.17	256.21	261.72	281.79	297.22	309.19	319.52	325.81	331.53	335.04	125.04
IMPLL VAC	230.37	252.43	273.49	286.79	290.37	303.66	314.13	322.35	328.79	333.85	337.85	342.66	
EPSILON	1.030	1.447	2.310	3.407	3.845	6.539	11.259	19.515	33.928	59.110	103.209	1.000	
	COMPOSITION SHIFTING (MOL/100 GM)												
28.92 CL	.1049	.0581	.0237	.0060	.0014	.0008	.0001	.0000	.0000	.0000	.0000	.0000	.0701
-13.50 CL*F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-38.87 CL*F3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-21.97 CL*H	.5978	.6448	.6792	.6970	.7017	.7022	.7030	.7030	.7030	.7030	.7030	.7030	.6424
.00 CL2	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
18.46 F	.0070	.0019	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0028
-64.50 F*H	2.1021	2.1072	2.1088	2.1091	2.1091	2.1091	2.1091	2.1091	2.1091	2.1091	2.1091	2.1091	2.1063
58.60 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.1906	.0982	.0375	.0089	.0019	.0011	.0001	.0000	.0000	.0000	.0000	.0000	.1208
19.20 F*H	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.7389	.7591	.7715	.7767	.7779	.7780	.7782	.7782	.7782	.7781	.7781	.7778	.7543
40.30 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
115.00 N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	1.0920	1.0921	1.0921	1.0921	1.0921	1.0921	1.0921	1.0921	1.0921	1.0921	1.0921	1.0920	1.0921

SYSTEM LIQUID BIPROPELLANT										PC 300	PSIA	HEAT FORM		WT. 8/9	
COMPONENT										REF FORMULA	DENSITY				
DEG K										GM/CC		KCAL/FORM.WT.1			
298 CL+FS										1.880		-44.35		65.	
298 H2+HN										1.004		+12.05		55.	
FROZEN EXPANSION										C STAR = 5737.7 FT/SEC					
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DELTVAC	DELTVAC	LVL	1 SEA	1 AT	1 AT	1 VAC	CF SEA	CF VAC
			DEG K	KCAL/100GM	GM DEG						10000	50000			
1.000	1.000	300.000	3391.2	-18.02	.418	.412	174.8	97.1	.594	215.1	217.8	222.9	225.9	1.206	1.250
2.000	1.037	163.295	2945.7	-36.51	.412	.412	174.8	97.1	.594	215.1	217.8	222.9	225.9	1.206	1.250
3.000	10.078	29.769	1978.5	-75.44	.391	.223.9	36.4	1.224	242.3	247.7	250.2	260.3	1.359	1.460	1.460
4.000	18.475	16.045	1682.2	-86.87	.381	244.7	28.7	1.787	247.2	255.1	270.4	275.5	1.586	1.533	1.533
5.000	29.248	10.250	1500.5	-93.73	.374	250.7	24.4	2.385				277.0	281.1	1.576	1.576
6.000	41.367	7.252	1373.3	-98.45	.368	244.5	21.7	2.990				281.1	286.2	1.605	1.605
7.000	54.196	5.555	1277.4	-101.97	.364	270.2	19.8	3.588				283.9	290.0	1.626	1.626
8.000	68.465	4.355	1201.1	-104.73	.360	274.7	18.3	4.195				285.8	292.9	1.645	1.645
9.000	84.477	3.551	1136.4	-106.97	.357	278.2	17.1	4.814				287.1	295.3	1.656	1.656
10.000	100.500	2.985	1086.0	-108.95	.355	281.1	16.1	5.406				288.0	297.2	1.667	1.667
11.000	114.655	2.572	1040.9	-110.44	.353	283.4	15.3	5.946				288.7	298.9	1.676	1.676
12.000	134.363	2.233	1001.5	-111.83	.351	285.7	14.6	6.560				289.1	300.3	1.684	1.684
13.000	153.455	1.954	964.7	-113.05	.349	287.5	14.0	7.187				289.3	301.6	1.691	1.691
14.000	173.267	1.731	935.6	-114.13	.348	289.2	13.5	7.807				289.4	302.7	1.697	1.697
15.000	193.504	1.550	907.7	-115.10	.347	290.6	13.0	8.417				303.7	1.703	1.703	1.703
16.000	214.053	1.402	882.5	-115.97	.345	291.9	12.6	9.011				304.5	1.708	1.708	1.708
17.000	234.750	1.278	859.4	-116.77	.344	293.1	12.3	9.598				305.3	1.712	1.712	1.712
18.000	255.630	1.174	838.1	-117.49	.343	294.2	11.9	10.166				306.8	1.716	1.716	1.716
19.000	277.057	1.083	818.8	-118.16	.343	295.2	11.6	10.707				307.4	1.720	1.720	1.720
20.000	300.841	.997	800.7	-118.78	.342	296.1	11.3	11.333				307.4	1.724	1.724	1.724
21.000	325.183	.923	785.9	-119.34	.341	296.9	11.0	11.944				307.9	1.727	1.727	1.727
22.000	350.046	.857	768.3	-119.89	.341	297.7	10.8	12.582				308.5	1.730	1.730	1.730
23.000	375.357	.799	753.6	-120.39	.340	298.4	10.6	13.202				309.0	1.733	1.733	1.733
24.000	401.042	.748	739.9	-120.86	.340	299.1	10.3	13.816				309.4	1.735	1.735	1.735
25.000	427.034	.703	726.9	-121.29	.339	299.7	10.1	14.424				309.9	1.738	1.738	1.738
26.000	453.270	.662	714.7	-121.71	.339	300.3	9.9	15.023				310.3	1.740	1.740	1.740
27.000	479.696	.625	703.2	-122.10	.338	300.9	9.8	15.613				310.7	1.742	1.742	1.742
28.000	506.243	.593	692.2	-122.47	.338	301.4	9.6	16.193				311.0	1.744	1.744	1.744
29.000	532.944	.563	681.9	-122.82	.338	301.9	9.4	16.762				311.4	1.746	1.746	1.746
30.000	559.462	.536	672.0	-123.15	.337	302.3	9.3	17.321				311.7	1.748	1.748	1.748
31.000	586.486	.512	662.4	-123.47	.337	302.9	9.1	17.870				312.0	1.750	1.750	1.750
32.000	614.275	.488	653.6	-123.77	.337	303.3	9.0	18.437				312.3	1.751	1.751	1.751
33.000	644.447	.466	645.0	-124.06	.336	303.7	8.9	19.002				312.6	1.753	1.753	1.753
34.000	675.080	.446	636.8	-124.34	.336	304.1	8.7	19.567				312.9	1.754	1.754	1.754
35.000	706.144	.425	628.9	-124.60	.336	304.5	8.6	20.132				313.1	1.756	1.756	1.756
36.000	737.406	.407	621.3	-124.84	.336	304.9	8.5	20.697				313.4	1.757	1.757	1.757
37.000	769.434	.390	614.0	-125.10	.335	305.2	8.4	21.260				313.6	1.759	1.759	1.759
38.000	801.599	.374	607.1	-125.34	.335	305.5	8.3	21.811				313.8	1.760	1.760	1.760
39.000	834.003	.360	600.3	-125.56	.335	305.9	8.2	22.360				314.1	1.761	1.761	1.761
40.000	866.812	.346	593.8	-125.78	.335	306.2	8.1	22.915				314.3	1.762	1.762	1.762
41.000	899.802	.333	587.6	-125.99	.335	306.5	8.0	23.467				314.5	1.763	1.763	1.763
42.000	933.011	.322	581.6	-126.19	.335	306.8	7.9	24.035				314.7	1.765	1.765	1.765
43.000	966.411	.310	575.7	-126.39	.334	307.0	7.8	24.598				314.9	1.766	1.766	1.766
44.000	999.978	.300	570.1	-126.57	.334	307.3	7.8	25.157				315.1	1.767	1.767	1.767
45.000	1033.689	.290	564.6	-126.74	.334	307.6	7.7	25.731				315.2	1.768	1.768	1.768
46.000	1067.524	.281	559.4	-126.93	.334	307.8	7.6	26.319				315.4	1.769	1.769	1.769
47.000	1101.443	.272	554.2	-127.10	.334	308.1	7.5	26.901				315.6	1.770	1.770	1.770
48.000	1135.449	.264	549.1	-127.27	.334	308.3	7.4	27.477				315.7	1.771	1.771	1.771
49.000	1169.588	.257	544.5	-127.43	.334	308.5	7.4	28.049				315.9	1.771	1.771	1.771
50.000	1203.748	.249	539.8	-127.59	.334	308.7	7.3	28.614				316.0	1.772	1.772	1.772
51.179	20.414	14.696	1643.8	-68.33	.379	247.3	27.8	1.890	247.3	255.7	271.9	275.1	1.587	1.543	1.543

SHIFTING EXPANSION														
C STAR = 5694.1 FT/SEC														
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DELTVAC	DELTVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC
			DEG K	KCAL/100GM	GM DEG				LVL	10000	50000			
1.000	1.000	300.000	3391.2	-18.02	.410	.712	125.0	102.6	.411	218.7	221.4	226.6	227.7	1.243
2.000	1.165	168.054	3105.7	-35.99	.402	226.8	41.1	1.265	249.2	254.8	265.7	267.8	1.361	1.494
3.000	16.820	17.835	2025.4	-89.83	.410	250.0	32.8	1.839	255.7	263.9	279.6	282.8	1.396	1.544
4.000	26.162	11.676	1825.1	-97.79	.390	243.4	28.0	2.444				287.3	291.5	1.591
5.000	36.864	8.148	1681.7	-105.32	.381	246.1	25.3	3.070				292.2	297.1	1.623
6.000	48.351	6.200	1572.1	-107.45	.375	276.9	22.8	3.679				295.5	301.7	1.647
7.000	60.445	4.931	1484.5	-110.71	.371	284.0	21.2	4.291				297.8	305.1	1.666
8.000	74.631	4.020	1412.3	-113.36	.367	288.0	19.8	4.935				299.5	307.9	1.681
9.000	89.954	3.372	1351.2	-115.41	.364	291.9	18.5	5.564				300.7	311.1	1.693
10.000	105.539	2.897	1298.6	-117.52	.361	294.2	17.9	6.165				301.4	312.1	1.704
11.000	118.179	2.535	1252.7	-119.17	.359	296.4	17.1	6.735				302.3	313.7	1.713
12.000	134.338	2.233	1211.9	-120.63	.357	298.8	16.4	7.352				302.7	315.2	1.721
13.000	151.587	1.979	1175.5	-121.93	.355	300.7	15.8	7.995				302.8	316.5	1.728
14.000	169.953	1.771	1142.7	-123.09	.354	302.3	15.3	8.634				302.9	317.6	1.734
15.000	187.505	1.600	1112.8	-124.15	.352	303.9	14.8	9.263				318.7	1.740	
16.000	205.929	1.457	1085.5	-125.11	.351	305.2	14.4	9.880				319.6	1.745	
17.000	224.524	1.334	1060.4	-125.99	.350	306.5	14.0	10.480				320.5	1.749	
18.000	243.219	1.233	1037.3	-126.80	.349	307.6	13.6	11.064				321.5	1.754	
19.000	261.966	1.145	1015.8	-127.54	.348	308.7	13.3	11.631				322.0	1.758	
20.000	281.831	1.064	995.7	-128.24	.347	309.7	13.0	12.228				322.7	1.761	
21.000	303.234	.989	976.9	-128.89	.346	310.4	12.7	12.870				323.3	1.765	
22.000	325.163	.923	959.3	-129.50	.345	311.4	12.5	13.512				323.9	1.768	
23.000	347.385	.864	942.7	-130.07	.344	312.2	12.2	14.152				324.4	1.771	
24.000	370.023	.811	927.1	-130.60	.343	313.0	12.0	14.789				325.0	1.774	
25.000	392.969	.763	912.4	-131.11	.342	313.7	11.8	15.421				325.4	1.776	
26.000	416.173	.721	898.4	-131.59	.342	314.3	11.6	16.047				325.9	1.779	
27.000	439.589	.682	885.1	-132.04	.341	315.0	11.4	16.667				326.4	1.782	
28.000	463.174	.643	872.5	-132.47	.341	315.5	11.2	17.278				326.7	1.784	
29.000	486.897	.616	860.5	-132.88	.340	316.1	11.0	17.881				327.1	1.786	
30.000	510.721	.587	849.0	-133.27	.339	316.4	10.9	18.475				327.5	1.788	
31.000	534.624	.561	838.0	-133.64	.339	317.2	10.7	19.059				327.9	1.790	
32.000	558.585	.535	827.5	-133.98	.338	317.9	10.5	19.634				328.2	1.792	
33.000	582.594	.515	817.5	-134.34	.338	318.1	10.4	20.201				328.5	1.793	
34.000	606.687	.494	807.8	-134.67	.338	318.4	10.3	20.764				328.8	1.795	
35.000	631.080	.473	798.5	-134.98	.337	319.0	10.1	21.305				329.1	1.797	
36.000	656.004	.451	789.6	-135.28	.337	319.8	10.0	21.838				329.4	1.798	
37.000	680.478	.428	781.0	-135.57	.336	319.8	9.9	22.468				329.7	1.800	
38.000	716.381	.419	772.7	-135.85	.336	320.2	9.8	23.129				329.9	1.801	
39.000	744.589	.403	764.8	-136.12	.336	320.5	9.7	23.790				330.2	1.802	
40.000	773.082	.388	757.1	-136.37	.336	320.7	9.5	24.400				330.4	1.803	
41.000	801.859	.371	749.4	-136.62	.335	321.2	9.4	25.046				330.7	1.805	
42.000	830.830	.361	742.4	-136.87	.335	321.5	9.3	25.681				330.9	1.806	
43.000	860.043	.349	735.4	-137.10	.335	321.9	9.2	26.315				331.1	1.807	
44.000	889.456	.337	728.7	-137.33	.334	322.7	9.2	27.163				331.3	1.809	
45.000	919.061	.325	722.1	-137.54	.334	322.7	9.1	27.944				331.4	1.810	
46.000	948.769	.314	715.8	-137.74	.334	322.7	9.0	28.790				331.7	1.811	
47.000	978.494	.307	709.6	-137.94	.334	323.0	9.0	29.008				331.9	1.812	
48.000	1008.114	.297	703.6	-138.16	.334	323.3	8.8	29.621				332.1	1.813	
49.000	1038.495	.289	697.8	-138.34	.333	323.6	8.7	30.223				332.4	1.814	
50.000	1069.072	.282	692.2	-138.50	.333	323.8	8.6	30.833				332.5	1.815	
3.462	20.143	6.046	1934.7	-93.48	.400	254.2	30.6	2.081	256.2	265.4	283.2	286.8	1.399	1.516

SYSTEM LIQUID BIPROPELLANT COMPONENT	REF. FORMULA	PC	300	PSIA	DENSITY	HEAT FORM	WT. C/O
	LEG. K				GM/CC	(KCAL/FORM.WT.)	
SYSTEM LIQUID BIPROPELLANT		PC	500	PSIA			
298	CLF3				1.880	-44.35	70.
298	N2H4				1.004	+12.05	30.

BULK DENSITY = 1.490 GM/CC
MIXTURE RATIO = 2.333 LB OXIDIZER / LB OF FUEL

CHAMBER ENTROPY 256.71 EU/100GMS

CLAMBER

THREAT

FROZEN EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	163.3
TEMP, DEG K	3603.8	2986.4	2465.2	2025.5	1735.5	1654.8	1334.3	1082.2	866.7	689.7	547.2	453.3	3125.3
ENTHALPY (-)	22.30	46.06	65.72	81.91	92.32	95.17	105.98	114.72	121.74	127.34	131.68	135.33	40.75
CP	.3882	.3810	.3728	.3630	.3548	.3521	.3408	.3297	.3205	.3145	.3110	.3093	.3830
IMPLL CPT	143.76	194.45	227.72	246.81	251.79	269.81	283.55	294.12	302.50	308.64	313.58	316.70	126.70
IMPLL VAC	225.38	244.18	262.67	274.44	277.61	289.37	298.55	305.69	311.26	315.61	319.01	323.62	
EPSILON	1.021	1.388	2.168	3.167	3.567	6.016	10.272	17.652	30.453	52.695	91.459	1.000	

	SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	169.3	
TEMP, DEG K	363.8	322.1	285.0	244.7	220.2	211.6	175.6	144.0	117.3	94.9	76.2	60.9	352.0	
ENTHALPY (-)	22.30	46.73	68.11	86.69	99.12	102.58	115.90	126.88	135.87	143.15	149.02	153.72	40.08	
X BAR	4.545	4.461	4.394	4.350	4.332	4.329	4.324	4.323	4.323	4.323	4.323	4.322	4.483	
N	4.545	4.461	4.394	4.350	4.332	4.329	4.323	4.323	4.323	4.323	4.323	4.322	4.483	
CP	.8850	.7645	.6297	.4967	.4184	.4015	.3582	.3403	.3263	.3178	.3098	.3051	.8003	
IMPLL OPT	145.78	199.63	236.68	258.51	264.27	285.35	301.64	314.32	324.24	332.07	338.12	342.36		
IMPLL VAC	230.94	253.94	276.21	290.42	294.24	308.40	319.57	328.29	335.19	340.61	344.86	348.08		
EPSILON	1.032	1.065	2.375	3.544	4.010	6.668	11.873	20.651	36.026	62.912	109.978	1.000		

COMPOSITION SHIFTING (MCL/100 GM)

[illegible]

PRESSURE PROFILE DATA
 SYSTEM LIQUID HYDROPELLANT PC 300 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. C/O
 DEG K GM/CC (KCAL/FORM.WT.)
 298 CL*F3 1.880 -44.35 75.
 298 H2*H4 1.004 +12.05 25.

BULK DENSITY = 1.543 GM/CC
 MIXTURE RATIO = 3.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 242.28 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	162.8
TEMP, DEG K	3765.6	3108.4	2556.3	2093.1	1788.7	1704.2	1378.7	1107.6	884.0	701.9	555.4	438.7	3253.6
ENTHALPY (-)	26.58	49.82	69.10	84.86	94.97	97.74	108.19	116.61	123.36	128.73	132.99	136.36	44.77
CP	.3578	.3515	.3444	.3356	.3264	.3200	.3159	.3059	.2977	.2925	.2894	.2879	.3531
IMPLL OPT	142.40	172.33	225.17	243.93	248.81	266.45	279.87	290.17	298.11	304.26	309.04	314.29	125.80
IMPLL VAC	223.07	241.45	259.52	271.03	274.12	285.57	294.49	301.43	306.81	311.01	314.29	314.29	221.38
EPSILON	1.020	1.383	2.154	3.141	3.535	5.947	10.130	17.365	29.887	51.600	89.357	1.000	
	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	169.1
TEMP, DEG K	3765.6	3382.5	3017.8	2663.0	2387.6	2301.4	1925.3	1609.5	1358.2	1126.6	914.1	734.1	3489.5
ENTHALPY (-)	26.58	50.63	71.78	90.28	102.76	106.27	119.80	131.04	140.44	148.29	154.71	159.88	44.08
X FAK	4.275	4.191	4.121	4.066	4.037	4.032	4.021	4.004	3.979	3.965	3.963	3.963	4.214
N	4.275	4.191	4.121	4.066	4.037	4.032	4.021	4.004	3.979	3.965	3.963	3.963	4.214
CP	.4999	.7821	.6659	.5445	.4417	.4101	.3496	.3913	.3766	.3185	.2925	.2840	.8153
IMPLL OPT	144.66	198.31	235.40	257.44	263.29	284.77	301.45	314.73	325.39	333.86	340.54	347.41	123.41
IMPLL VAC	229.39	252.52	275.16	289.81	293.76	308.28	319.94	329.58	337.26	343.24	347.93	347.93	226.42
EPSILON	1.032	1.471	2.403	3.616	4.100	7.044	12.336	22.063	39.288	69.147	121.224	1.000	
	COMPOSITION SHIFTING (MOL/100 GM)												
28.92 CL	.4020	.3388	.2642	.1898	.1450	.1357	.1165	.0830	.0325	.0057	.0004	.0000	.3584
-13.50 CL*F	.0003	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
-38.87 CL*F3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-21.97 CL*H	.4068	.4765	.5455	.6201	.6646	.6736	.6865	.6868	.6868	.6868	.6868	.6868	.4508
.00 CL2	.0010	.0008	.0007	.0007	.0008	.0009	.0041	.0207	.0460	.0594	.0620	.0622	.0009
14.86 F	.0722	.0324	.0122	.0037	.0015	.0009	.0002	.0000	.0000	.0000	.0000	.0000	.0415
-64.50 F*H	2.3611	2.4010	2.4213	2.4298	2.4323	2.4326	2.4334	2.4335	2.4336	2.4336	2.4336	2.4336	2.3919
58.60 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.1498	.0861	.0396	.0124	.0030	.0017	.0000	.0000	.0000	.0000	.0000	.0000	.1027
79.20 F*H	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.1013	.0814	.0569	.0290	.0102	.0062	.0002	.0000	.0000	.0000	.0000	.0000	.0874
40.30 F2*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 H	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
.00 H2	.7799	.7800	.7801	.7801	.7801	.7801	.7801	.7801	.7801	.7801	.7801	.7801	.7800

SYSTEM LIQUID BIPROPELLANT										PC 300		PSIA		DENSITY		HEAT FORM		WT. O/D	
COMPONENT										THEF FORMULA		GP/CC		(KCAL/FORM.WT.)					
										DEG K		1.88		-44.35		75.			
										298 CL=63		1.004		+12.05		25.			
										298 N2=H4									
										C STAR = 5400.5 FT/SEC									
										C STAR = 5400.5 FT/SEC									
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC					
			DEG K	KCAL/100GM	GM DEG		/P	/P	LVL	10000	50000	LVL	LVL	LVL					
1.000	1.000	300.000	3765.6	-26.58	.358		125.8	95.6	.587	212.8	215.4	220.4	221.4	1.208	1.257				
2.000	10.194	29.430	2134.7	-82.80	.137	221.5	35.5	1.207	239.3	244.6	254.9	257.0	1.359	1.459					
3.000	10.014	15.778	1822.8	-93.85	.129	241.9	27.8	1.764	243.8	251.6	266.8	269.8	1.385	1.532					
4.000	29.911	10.030	1620.3	-100.46	.124	253.5	23.6	2.354	273.1	277.1	287.1	289.1	1.574	1.602					
5.000	42.337	7.086	1479.5	-104.99	.119	261.2	20.9	2.953	277.1	282.1	289.7	291.7	1.602	1.622					
6.000	55.544	5.401	1373.7	-108.34	.114	266.7	19.0	3.524	279.7	285.7	289.7	291.7	1.639	1.651					
7.000	70.745	4.241	1269.7	-110.99	.113	271.0	17.6	4.146	281.5	288.6	290.8	292.8	1.651	1.666					
8.000	86.794	3.454	1220.8	-113.13	.110	274.4	16.4	4.754	282.7	290.8	291.9	293.9	1.666	1.679					
9.000	103.252	2.904	1163.0	-114.91	.108	277.2	15.5	5.334	283.6	292.7	293.9	295.9	1.679	1.686					
10.000	119.826	2.504	1113.5	-116.43	.104	279.6	14.7	5.879	284.3	294.3	295.9	297.9	1.686	1.692					
11.000	138.552	2.165	1070.3	-117.75	.104	281.6	14.0	6.406	284.8	294.8	295.9	297.9	1.692	1.697					
12.000	158.369	1.894	1032.2	-118.91	.103	283.4	13.5	7.103	285.0	294.9	295.9	297.9	1.697	1.702					
13.000	178.823	1.678	998.3	-119.94	.102	285.0	12.9	7.714	285.0	294.9	295.9	297.9	1.702	1.706					
14.000	199.731	1.507	967.8	-120.86	.101	286.4	12.5	8.312	285.0	294.9	295.9	297.9	1.706	1.710					
15.000	220.935	1.358	940.1	-121.69	.100	287.6	12.1	8.893	285.0	294.9	295.9	297.9	1.710	1.714					
16.000	242.313	1.238	915.0	-122.44	.099	288.8	11.7	9.456	285.0	294.9	295.9	297.9	1.714	1.717					
17.000	263.788	1.137	891.9	-123.13	.098	289.8	11.4	10.000	285.0	294.9	295.9	297.9	1.717	1.720					
18.000	286.992	1.045	870.7	-123.76	.097	290.8	11.1	10.586	285.0	294.9	295.9	297.9	1.720	1.723					
19.000	311.751	.962	851.0	-124.34	.097	291.6	10.8	11.204	285.0	294.9	295.9	297.9	1.723	1.726					
20.000	337.072	.890	832.7	-124.89	.096	292.4	10.5	11.822	285.0	294.9	295.9	297.9	1.726	1.728					
21.000	362.958	.827	815.7	-125.39	.096	293.2	10.3	12.436	285.0	294.9	295.9	297.9	1.728	1.731					
22.000	389.248	.771	799.7	-125.86	.095	293.9	10.1	13.046	285.0	294.9	295.9	297.9	1.731	1.733					
23.000	415.926	.721	784.8	-126.30	.095	294.5	9.8	13.649	285.0	294.9	295.9	297.9	1.733	1.735					
24.000	442.900	.677	770.7	-126.72	.094	295.0	9.6	14.244	285.0	294.9	295.9	297.9	1.735	1.737					
25.000	470.107	.634	757.4	-127.11	.094	295.7	9.5	14.830	285.0	294.9	295.9	297.9	1.737	1.739					
26.000	497.492	.603	744.9	-127.48	.094	296.3	9.3	15.406	285.0	294.9	295.9	297.9	1.739	1.742					
27.000	525.008	.571	733.0	-127.82	.093	296.8	9.1	15.972	285.0	294.9	295.9	297.9	1.742	1.744					
28.000	552.621	.543	721.7	-128.15	.093	297.3	9.0	16.527	285.0	294.9	295.9	297.9	1.744	1.745					
29.000	580.309	.517	711.0	-128.47	.093	297.7	8.8	17.071	285.0	294.9	295.9	297.9	1.745	1.747					
30.000	608.401	.493	700.8	-128.77	.092	298.2	8.7	17.615	285.0	294.9	295.9	297.9	1.747	1.748					
31.000	636.902	.469	691.0	-129.05	.092	298.6	8.6	18.158	285.0	294.9	295.9	297.9	1.748	1.750					
32.000	665.819	.447	681.7	-129.32	.092	299.0	8.4	18.699	285.0	294.9	295.9	297.9	1.750	1.751					
33.000	695.188	.427	672.8	-129.58	.092	299.4	8.3	19.239	285.0	294.9	295.9	297.9	1.751	1.752					
34.000	725.705	.408	664.2	-129.83	.092	299.7	8.2	19.778	285.0	294.9	295.9	297.9	1.752	1.753					
35.000	756.423	.390	656.0	-130.07	.091	300.1	8.1	20.317	285.0	294.9	295.9	297.9	1.753	1.755					
36.000	787.310	.374	648.2	-130.30	.091	300.4	8.0	20.856	285.0	294.9	295.9	297.9	1.755	1.756					
37.000	818.350	.359	640.4	-130.52	.091	300.7	7.9	21.395	285.0	294.9	295.9	297.9	1.756	1.757					
38.000	849.541	.345	633.3	-130.73	.091	301.0	7.8	21.934	285.0	294.9	295.9	297.9	1.757	1.758					
39.000	880.880	.332	626.3	-130.94	.091	301.3	7.7	22.473	285.0	294.9	295.9	297.9	1.758	1.759					
40.000	912.368	.320	619.5	-131.15	.091	301.6	7.6	23.012	285.0	294.9	295.9	297.9	1.759	1.760					
41.000	943.905	.308	613.0	-131.35	.090	301.9	7.5	23.551	285.0	294.9	295.9	297.9	1.760	1.761					
42.000	975.492	.298	606.7	-131.55	.090	302.1	7.4	24.090	285.0	294.9	295.9	297.9	1.761	1.762					
43.000	1007.129	.288	600.6	-131.74	.090	302.4	7.3	24.629	285.0	294.9	295.9	297.9	1.762	1.763					
44.000	1038.816	.278	594.7	-131.93	.090	302.6	7.2	25.168	285.0	294.9	295.9	297.9	1.763	1.764					
45.000	1070.553	.270	589.0	-132.12	.090	302.9	7.2	25.707	285.0	294.9	295.9	297.9	1.764	1.765					
46.000	1102.340	.261	583.5	-132.31	.090	303.1	7.1	26.246	285.0	294.9	295.9	297.9	1.765	1.766					
47.000	1134.177	.253	578.1	-132.49	.090	303.3	7.0	26.785	285.0	294.9	295.9	297.9	1.766	1.767					
48.000	1166.064	.246	572.9	-132.67	.090	303.5	7.0	27.324	285.0	294.9	295.9	297.9	1.767	1.768					
49.000	1198.001	.239	567.9	-132.85	.090	303.7	6.9	27.863	285.0	294.9	295.9	297.9	1.768	1.769					
50.000	1230.088	.233	563.0	-133.03	.089	304.0	6.8	28.402	285.0	294.9	295.9	297.9	1.769	1.770					
5.141	20.414	14.696	1788.7	-94.77	.328	243.9	27.1	1.844	243.9	252.1	267.9	271.0	1.385	1.539					

SHIFTING EXPANSION															
C STAR = 5879.7 FT/SEC															
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC	
			DEG K	KCAL/100GM	GM DEG		/P	/P	LVL	10000	50000	LVL	LVL	LVL	
1.000	1.000	300.000	3765.6	-26.58	.358		125.8	103.0	.409	217.5	220.2	225.4	226.4	1.239	1.190
2.000	10.194	29.430	2134.7	-82.80	.137	221.5	35.5	1.267	249.0	254.6	265.5	267.6	1.363	1.465	
3.000	10.014	15.778	1822.8	-93.85	.129	241.9			256.5	264.6	280.4	283.5	1.404	1.551	
4.000	10.000	12.515	1625.6	-108.44	.125	257.8			268.0	280.0	304.5	308.0	1.463	1.603	
5.000	10.000	9.311	1462.1	-121.12	.121	271.0				294.5	319.5	324.5	1.542	1.692	
6.000	10.000	6.934	1302.3	-136.05	.116	283.7				328.1	354.4			1.665	
7.000	10.000	5.540	1162.9	-151.06	.110	296.0				368.5	390.9	394.4		1.686	
8.000	10.000	4.521	1047.1	-162.57	.105	308.7				402.8	417.2			1.703	
9.000	10.000	3.815	950.0	-172.02	.101	321.0				438.5	441.1			1.717	
10.000	10.000	3.262	871.9	-172.11	.101	333.7				475.4	475.9			1.729	
11.000	10.000	2.862	808.1	-178.94	.102	346.4				513.4	513.4			1.739	
12.000	10.000	2.569	762.3	-183.54	.103	359.1				552.7	552.7			1.748	
13.000	10.000	2.341	731.8	-186.81	.103	371.7				593.3	593.3			1.756	
14.000	10.000	2.167	704.7	-188.25	.103	384.4				635.0	635.0			1.763	
15.000	10.000	2.047	685.2	-188.25	.103	397.0				677.8	677.8			1.770	
16.000	10.000	1.963	671.0	-185.48	.103	409.7				721.7	721.7			1.776	
17.000	10.000	1.906	661.0	-184.66	.103	422.4				766.7	766.7			1.782	
18.000	10.000	1.862	654.0	-183.20	.103	435.1				812.8	812.8			1.787	
19.000	10.000	1.829	648.6	-181.20	.103	447.8				860.0	860.0			1.791	
20.000	10.000	1.804	644.6	-178.70	.103	460.5				908.3	908.3			1.795	
21.000	10.000	1.786	641.0	-175.70	.103	473.2				957.7	957.7			1.799	
22.000	10.000	1.774	638.6	-172.20	.103	485.9				1008.2	1008.2			1.803	
23.000	10.000	1.765	637.0	-168.20	.103	498.6				1059.8	1059.8			1.807	
24.000	10.000	1.759	636.2	-163.70	.103	511.3				1112.5	1112.5			1.810	
25.000	10.000	1.756	636.0	-158.70	.103	524.0				1166.4	1166.4			1.813	
26.000	10.000	1.755	636.0	-153.20	.103	536.7				1221.5	1221.5			1.816	
27.000	10.000	1.756	636.0	-147.20	.103	549.4				1277.8	1277.8			1.819	
28.000	10.000	1.758	636.0	-140.70	.103	562.1				1335.3	1335.3			1.822	
29.000	10.000	1.761	636.0	-133.70	.103	574.8				1394.0	1394.0			1.825	
30.000	10.000	1.765	636.0	-126.20	.103	587.5				1453.9	1453.9			1.828	
31.000	10.000	1.770	636.0	-118.20	.103	599.9				1515.0	1515.0			1.831	
32.000	10.000	1.776	636.0	-108.70	.103	612.2				1577.3	1577.3			1.834	
33.000	10.000	1.783	636.0	-97.70	.103	624.5				1640.8	1640.8			1.837	
34.000	10.000	1.791	636.0	-85.20	.103	636.8				1705.5	1705.5			1.840	
35.000	10.000	1.800	636.0	-71.20	.103	649.1				1771.5	1771.5			1.843	
36.000	10.000	1.810	636.0	-55.70	.103	661.4				1838.8	1838.8			1.846	
37.000	10.000	1.821	636.0	-38.70	.103	673.7				1907.4	1907.4			1.849	
38.000	10.000	1.833	636.0	-20.20	.103	686.0				1977.3	1977.3			1.852	
39.000	10.000	1.846	636.0	0.00	.103	698.3				2048.5	2048.5			1.855	
40.000	10.000	1.860	636.0	19.20	.103	710.6				2120.9	2120.9			1.858	
41.000	10.000	1.875	636.0	37.20	.103	722.9				2194.5	2194.5			1.861	
42.000	10.000	1.891	636.0	53.90	.103	735.2				2269.4	2269.4			1.864	
43.000	10.000	1.908	636.0	69.20	.103	747.5				2345.6	2345.6			1.867	
44.000	10.000	1.926	636.0	83.10	.103	759.8				2423.1	2423.1			1.870	
45.000	10.000	1.945	636.0	95.60	.103	772.1				2501.9	2501.9			1.873	
46.000	10.000	1.965	636.0	106.70	.103	784.4				2582.1	2582.1			1.876	
47.000	10.000	1.986	636.0	116.40	.103	796.7				2663.7	2663.7			1.879	
48.000	10.000	2.008	636.0	124.70	.103	809.0				2746.8	2746.8			1.882	
49.000	10.000	2.031	636.0	131.60	.103	821.3				2831.4	2831.4			1.885	
50.000	10.000	2.055	636.0	137.10	.103	833.6				2917.5	2917.5			1.888	
51.000	10.000	2.080	636.0	141.30	.103	845.9				3005.1	3005.1			1.891	
52.000	10.000	2.106	636.0	144.20	.103	858.2				3094.2	3094.2			1.894	
53.000	10.000	2.133	636.0	145.80	.103	870.5				3184.8	3184.8			1.897	
54.000	10.000	2.161	636.0	146.10	.103	882.8				3276.9	3276.9			1.900	
55.000	10.000	2.190	636.0	145.10	.103	895.1				3370.5	3370.5			1.903	
56.000	10.000	2.220	636.0	142.80	.103	907.4				3465.6	3465.6			1.906	
57.000	10.000	2.251	636.0	139.10	.103	919.7				3562.2	3562.2			1.909	
58.000	10.000	2.283	636.0	134.00	.103	932.0				3660.3	3660.3			1.912	
59.000	10.000	2.316	636.0	127.50	.103	944.3				3760.0	3760.0			1.915	
60.000	10.000	2.350	636.0	119.60	.103	956.6				3861.3	3861.3			1.918	
61.000	10.000	2.385	636.0	110.30	.103	968.9				3964.2	3964.2			1.921	
62.000	10.000	2.421	636.0	99.60	.103	981.2				4068.7	4068.7			1.924	
63.000	10.000	2.458	636.0	87.50	.103	993.5				4174.8	4174.8			1.927	
64.000	10.000	2.496	636.0	74.00	.103	1005.8				4282.5	4282.5			1.930	
65.000	10.000	2.535	636.0	59.10	.103	1018.1				4391.8	4391.8			1.933	
66.000	10.000	2.575	636.0	42.80	.103	1030.4				4502.7	4502.7			1.936	
67.000	10.000	2.616	636.0	25.10	.103	1042.7				4615.2	4615.2			1.939	
68.000	10.000	2.658	636.0	6.00	.103	1055.0				4729.3	4729.3			1.942	
69.000	10.000	2.702	636.0	-14.50	.103	1067.3				4845.0	4845.0			1.945	
70.000	10.000	2.747	636.0	-34.70	.103	1079.6				4962.3	4962.3			1.948	
71.000	10.000	2.794	636.0	-53.50	.103	1091.9				5081.2	5081.2			1.951	
72.000	10.000	2.842	636.0	-70.80	.103	1104.2				5201.7	5201.7			1.954	
73.000	10.000	2.892	636.0	-86.60	.103	1116.5				5323.8	5323.8			1.957	
74.000	10.000	2.943	636.0	-100.90	.103	1128.8				5447.5	5447.5			1.960	
75.000	10.000	2.996	636.0	-113.70	.103	1141.1				5572.8	5572.8			1.963	
76.000	10.000	3.050	636.0	-125.00	.103	1153.4				5699.7	5699.7			1.966	
77.000	10.000	3.106	636.0	-134.80	.103	1165.7				5828.1	5828.1			1.969	
78.000	10.000	3.163	636.0	-143.10	.103	1178.0				5958.1	5958.1			1.972	
79.000	10.000	3.222	636.0	-149.90	.103	1190.3				6089.6	6089.6			1.975	
80.000	10.000	3.282	636.0	-155.20	.103	1202.6				6222.6	6222.6			1.978	
81.000	10.000	3.344	636.0	-159.00	.103	1214.9				6357.1	6357.1			1.981	
82.000	10.000	3.407	636.0	-161.30	.103	1227.2				6493.1	6493.1			1.984	
83.000	10.000	3.472	636.0	-162.10	.103	1239.5				6630.6	6630.6			1.987	
84.000	10.000	3.539	636.0	-161.50	.103	1251.8				6769.6	6769.6			1.990	
85.000	10.000	3.607	636.0	-159.50	.103	1264.1				6910.1	6910.1			1.993	
86.000	10.000	3.677	636.0	-156.10	.103	1276.4				7052.1	7052.1			1.996	
87.000	10.000	3.748	636.0	-151.30	.103	1288.7				7195.6	7195.6			1.999	
88.000	10.000	3.821	636.0	-145.10	.103	1301.0				7340.6	7340.6			2.002	
89.000	10.000	3.896	636.0	-137.50	.103	1313.3				7487.1	7487.1			2.005	
90.000	10.000	3.972	636.0	-128.60	.103	1325.6				7635.1	7635.1			2.008	
91.000	10.000	4.050	636.0	-118.30	.103	1337.9				7784.6	7784.6			2.011	
92.000	10.000	4.130	636.0	-106.60	.103	1350.2				7935.6	7935.6			2.014	</

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPHOPPELLANT PC 300 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 298 CL+F3 1.88 -44.35 80.
 298 N2+H4 1.004 +12.05 20.

BULK DENSITY = 1.601 GM/CC
 MIXTURE RATIO = 4.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTRCPY 227.16 EU/100GMS

CHAMBER	FROZEN EXPANSION												THROAT
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	161.9
TEMP, DEG K	3523.0	2887.2	2349.8	1902.9	1612.2	1532.0	1225.1	973.5	769.5	606.3	476.8	374.8	3025.4
ENTHALPY (-)	30.85	51.67	68.65	82.44	91.19	93.57	102.51	109.63	115.28	119.74	123.25	126.00	47.25
CP	.3250	.3193	.3124	.3045	.2976	.2957	.2866	.2795	.2745	.2717	.2704	.2692	.3206
INPUL OPT		134.56	181.33	211.84	229.11	233.59	249.68	261.79	271.01	278.07	283.51	287.69	119.42
INPUL VAC		210.4	227.13	243.60	253.98	256.77	267.02	274.93	281.05	285.78	289.45	292.30	208.97
EPSILON		1.618	1.569	2.114	3.061	3.437	5.726	9.665	16.434	28.106	48.271	83.288	1.000
SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	164.9
TEMP, DEG K	3523.0	3004.1	2552.0	2212.9	2015.3	1960.1	1757.2	1580.3	1412.4	1236.7	1042.3	849.4	5133.8
ENTHALPY (-)	30.85	52.04	69.90	85.04	95.20	98.07	109.45	119.46	128.28	135.97	142.53	147.95	47.03
X BAR	4.089	4.067	4.035	3.975	3.915	3.896	3.813	3.735	3.671	3.626	3.606	3.603	4.072
N	4.089	4.067	4.035	3.975	3.915	3.896	3.813	3.735	3.671	3.626	3.606	3.603	4.072
CP	.4639	.4058	.4677	.6042	.7070	.7308	.7726	.7156	.5789	.4153	.3035	.2698	.4072
INPUL OPT		135.75	184.29	217.10	236.59	241.81	261.48	277.64	291.12	302.40	311.69	319.16	118.61
INPUL VAC		213.55	232.60	252.13	265.39	269.11	283.63	296.02	306.52	315.22	322.12	327.45	211.61
EPSILON		1.024	1.416	2.286	3.475	3.968	7.169	13.249	24.714	45.827	82.992	146.961	1.000
COMPOSITION SHIFTING (MCL/100 GPM)													
28.92 CL	.7030	.7377	.7294	.6499	.5543	.5222	.3799	.2436	.1267	.0438	.0070	.0004	.7310
-13.50 CL+F	.0037	.0065	.0143	.0285	.0421	.0464	.0643	.0796	.0907	.0971	.0992	.0995	.0055
-38.87 CL+F3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-21.97 CL+F	.1473	.0948	.0502	.0240	.0132	.0110	.0049	.0020	.0007	.0002	.0000	.0000	.1083
.CC CL2	.0056	.0131	.0357	.0814	.1279	.1429	.2081	.2701	.3236	.3621	.3795	.3827	.0103
18.86 F	.2577	.1890	.1355	.0950	.0706	.0641	.0401	.0220	.0095	.0027	.0003	.0000	.2047
-64.50 F+H	2.3344	2.4002	2.4460	2.4723	2.4831	2.4853	2.4914	2.4943	2.4956	2.4961	2.4962	2.4963	2.3856
58.60 F+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.CC F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.0114	.0010	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0020
79.20 F+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.CC F2	.0016	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
40.30 F+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.CC N2	.6240	.6241	.6241	.6241	.6241	.6241	.6241	.6241	.6241	.6241	.6241	.6241	.6241

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F_2-H_2 SYSTEM

PRESSURE PROFILE DATA			
SYSTEM LIQUID BIPROPELLANT PC-1000, PSIA			
COMPONENT	TRF FORMULA	DENSITY	HEAT FORM
DEG K	GM/CC	(KCAL/FORM.WT.)	WT. O/D
85.2 F2	1.51	-3.47	75.
20.4 H2	0.071	-1.887	25.

BULK DENSITY = .249 GM/CC
MIXTURE RATIO = 3.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 603.37 EU/100GMS

CHAMBER													THROAT
FROZEN EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	540.2
TEMP, DEG K	2348.3	1881.2	1491.6	1169.3	908.2	781.7	701.3	540.0	415.5	319.6	242.9	179.1	2026.9
ENTHALPY (-)	30.25	85.74	129.99	164.87	192.08	205.01	213.16	229.42	241.93	251.52	259.12	265.41	68.69
CP	1.2131	1.1611	1.1078	1.0582	1.0276	1.0166	1.0111	1.0054	1.0030	.9963	.9882	.9796	1.1788
IMPUL OPT		219.71	294.55	342.21	375.21	389.90	398.90	416.24	429.12	438.73	446.21	452.29	182.87
IMPUL VAC		326.18	357.52	384.70	405.31	414.83	420.76	432.37	441.16	447.79	452.98	457.21	320.70
EPSILON		1.048	1.557	2.639	4.696	6.649	8.569	15.882	29.773	56.263	105.638	192.975	1.000
SHIFTING EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	540.8
TEMP, DEG K	2348.3	1888.1	1498.1	1174.8	912.7	785.7	704.9	542.8	417.7	321.3	244.4	180.3	2033.6
ENTHALPY (-)	30.25	85.84	130.24	165.26	192.59	205.57	213.76	230.09	242.66	252.30	259.93	266.23	68.68
X BAR	14.384	14.375	14.375	14.374	14.374	14.374	14.374	14.374	14.374	14.374	14.374	14.374	14.377
N	14.384	14.375	14.375	14.374	14.374	14.374	14.374	14.374	14.374	14.374	14.374	14.374	14.377
CP	1.2627	1.1689	1.1092	1.0587	1.0278	1.0166	1.0109	1.0054	1.0028	.9964	.9868	.9798	1.1940
IMPUL OPT		219.91	294.93	342.70	375.80	390.53	399.55	416.95	429.86	439.50	446.99	453.08	182.84
IMPUL VAC		326.61	358.05	385.30	405.98	415.53	421.47	433.12	441.94	448.59	453.79	458.03	321.07
EPSILON		1.049	1.558	2.642	4.701	6.656	8.578	15.901	29.809	56.340	105.835	193.533	1.000
COMPOSITION SHIFTING (MOL/100 GM)													
18.86 F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-64.50 F+H	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.0183	.0017	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
.00 H2	10.4180	10.4263	10.4271	10.4271	10.4271	10.4271	10.4271	10.4271	10.4271	10.4271	10.4271	10.4271	10.4251

SYSTEM LIQUID HYDROFLUORIC PC-1000, PSIA																					
COMPONENT		TREF FORMULA		DENSITY		HEAT FORM		WT. 4/5													
DEG. F		85.7 F2		1.51		-3.47		75.													
20.4 F2		1.51		-3.47		75.		25.													
PROTEIN EXPANSION																					
C STAR = 222.9 BT/SEC																					
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/ I	OPT DELVAC	DELVAC I	SEA I	AT	I AT	I VAC	CP SEA	CP VAC								
			DEG. F	KCAL/100GM GR DEG			/P	LVL	10000	10000		LVL									
1.000	1.000	1000.000	234.0	-30.25	1.215																
2.000	10.076	91.045	1310.3	-109.00	1.001	322.3	49.7	541	344.1	340.5	371.1	372.0	1.427								
3.000	19.452	50.372	1104.3	-171.76	1.050	350.9	39.1	773	378.6	362.0	388.6	389.0	1.528								
4.000	31.440	31.579	973.4	-195.58	1.034	367.4	32.9	1.041	385.0	369.5	400.5	400.3	1.599								
5.000	45.970	27.100	865.2	-198.58	1.025	370.1	29.1	1.278	388.9	369.0	407.2	407.2	1.598								
6.000	58.526	17.146	817.0	-201.42	1.019	365.9	26.3	1.535	389.6	369.6	412.2	412.2	1.537								
7.000	73.453	11.577	768.7	-204.73	1.015	371.8	24.3	1.787	377.7	373.1	416.1	416.1	1.631								
8.000	90.257	11.080	722.2	-211.05	1.012	376.0	22.6	2.044	378.2	373.7	419.2	419.2	1.683								
9.000	107.879	9.278	680.7	-218.48	1.010	380.5	21.2	2.300	377.9	374.0	421.8	421.8	1.683								
10.000	126.952	7.877	656.4	-217.44	1.009	383.8	20.2	2.544	377.6	374.0	424.0	424.0	1.683								
11.000	146.980	6.802	640.5	-220.31	1.008	386.6	19.3	2.833	371.1	373.9	425.9	425.9	1.687								
12.000	167.739	5.962	607.7	-222.61	1.007	409.1	18.5	3.090	372.5	373.5	427.5	427.5	1.676								
13.000	189.273	5.297	584.2	-224.64	1.006	411.4	17.8	3.356	373.1	373.1	429.1	429.1	1.689								
14.000	210.581	4.791	569.5	-226.16	1.006	413.4	17.1	3.634	373.1	373.1	430.5	430.5	1.689								
15.000	232.106	4.398	553.1	-228.10	1.006	415.9	16.6	3.897	372.9	373.1	431.3	431.3	1.691								
16.000	254.096	4.030	538.3	-229.59	1.005	416.4	16.1	4.085	372.5	373.5	432.5	432.5	1.695								
17.000	277.270	3.781	524.8	-230.75	1.005	417.8	15.6	4.261	372.8	373.2	433.2	433.2	1.699								
18.000	300.512	3.547	512.5	-231.70	1.005	419.2	15.2	4.430	372.8	373.2	434.3	434.3	1.699								
19.000	321.807	3.319	500.6	-233.16	1.005	420.3	14.8	4.592	372.8	373.2	435.2	435.2	1.700								
20.000	350.436	3.100	490.2	-234.63	1.005	421.4	14.5	4.740	372.7	373.3	435.9	435.9	1.700								
21.000	386.476	2.887	480.3	-235.82	1.004	422.5	14.1	4.882	372.3	373.6	436.6	436.6	1.711								
22.000	418.816	2.676	471.1	-236.75	1.004	423.4	13.8	5.020	372.5	373.7	437.1	437.1	1.716								
23.000	442.345	2.461	462.4	-237.22	1.004	424.3	13.5	5.152	372.6	373.8	437.4	437.4	1.716								
24.000	470.444	2.240	454.3	-238.03	1.004	425.2	13.3	5.284	372.8	373.9	438.4	438.4	1.716								
25.000	498.340	2.020	446.7	-238.80	1.004	425.9	13.0	5.409	372.9	374.0	439.0	439.0	1.721								
26.000	526.431	1.805	439.4	-239.52	1.004	426.6	12.8	5.528	372.8	374.1	439.5	439.5	1.723								
27.000	554.245	1.590	432.4	-240.20	1.003	427.4	12.6	5.642	372.8	374.1	440.0	440.0	1.725								
28.000	582.282	1.377	426.2	-240.84	1.003	428.0	12.4	5.750	372.8	374.1	440.4	440.4	1.726								
29.000	609.816	1.160	420.0	-241.47	1.003	428.7	12.2	5.850	372.8	374.1	440.8	440.8	1.728								
30.000	636.350	1.047	414.2	-242.06	1.003	429.2	12.0	5.950	372.8	374.1	441.2	441.2	1.730								
31.000	671.200	0.930	408.3	-242.63	1.003	429.8	11.8	6.050	372.8	374.1	441.6	441.6	1.731								
32.000	704.423	0.810	403.1	-243.15	1.003	430.3	11.7	6.150	372.8	374.1	442.0	442.0	1.733								
33.000	736.550	0.750	399.2	-243.64	1.002	430.9	11.5	6.250	372.8	374.1	442.3	442.3	1.734								
34.000	772.660	0.690	395.3	-244.15	1.002	431.4	11.3	6.350	372.7	374.1	442.7	442.7	1.735								
35.000	807.809	0.630	390.7	-244.61	1.002	431.8	11.2	6.450	372.7	374.1	443.0	443.0	1.737								
36.000	843.041	0.570	386.2	-245.04	1.002	432.1	11.0	6.550	372.7	374.1	443.3	443.3	1.738								
37.000	878.423	0.510	379.9	-245.49	1.001	432.7	10.9	6.650	372.7	374.1	443.6	443.6	1.739								
38.000	914.516	0.450	375.7	-245.91	1.001	433.1	10.8	6.750	372.7	374.1	443.9	443.9	1.740								
39.000	950.673	0.390	371.8	-246.31	1.001	433.5	10.7	6.850	372.7	374.1	444.2	444.2	1.741								
40.000	987.041	0.330	367.9	-246.68	1.000	433.9	10.5	6.950	372.7	374.1	444.5	444.5	1.743								
41.000	1023.639	0.270	364.2	-247.04	1.000	434.3	10.4	7.050	372.7	374.1	444.7	444.7	1.743								
42.000	1060.371	0.210	360.6	-247.32	1.000	434.7	10.3	7.150	372.7	374.1	445.0	445.0	1.744								
43.000	1097.222	0.150	357.1	-247.77	1.000	435.0	10.2	7.250	372.7	374.1	445.2	445.2	1.745								
44.000	1134.168	0.100	353.6	-248.15	1.000	435.4	10.1	7.350	372.7	374.1	445.4	445.4	1.746								
45.000	1171.198	0.050	350.5	-248.43	1.000	435.7	10.0	7.450	372.7	374.1	445.7	445.7	1.747								
46.000	1208.165	0.000	347.3	-248.75	1.000	436.0	9.9	7.550	372.7	374.1	445.9	445.9	1.748								
47.000	1245.180	0.000	344.3	-249.05	1.000	436.3	9.8	7.650	372.7	374.1	446.1	446.1	1.749								
48.000	1282.173	0.000	341.3	-249.35	1.000	436.6	9.7	7.750	372.7	374.1	446.3	446.3	1.749								
49.000	1319.120	0.000	338.0	-249.59	1.000	436.9	9.6	7.850	372.7	374.1	446.5	446.5	1.750								
50.000	1356.006	0.000	335.4	-249.82	1.000	437.1	9.5	7.950	372.7	374.1	446.7	446.7	1.751								
6.649	60.946	10.496	781.7	-205.01	1.017	389.9	24.9	1.696	389.9	389.4	411.9	411.9	1.520								

SHIFTING EXPANSION													
C STAR = 222.9 BT/SEC													
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/ I	OPT DELVAC	DELVAC I	SEA I	I AT	I AT	I VAC	CP SEA	CP VAC
			DEG F	KCAL/100GM	GR DEG		/P	LVL	10000	10000		LVL	
1.000	1.000	1000.000	234.0	-30.25	1.263								
2.000	10.050	92.116	1325.0	-109.27	1.002	322.0	49.9	542	344.6	347.0	371.6	372.6	1.427
3.000	19.422	50.443	1110.0	-172.11	1.050	351.6	39.2	777	379.1	362.0	390.2	390.5	1.528
4.000	31.422	31.624	978.5	-195.81	1.035	367.9	33.0	1.063	385.0	369.2	400.9	400.9	1.599
5.000	45.908	25.175	868.5	-198.85	1.025	370.6	29.2	1.280	388.9	369.2	407.8	407.8	1.598
6.000	58.233	17.172	821.5	-201.97	1.019	366.5	26.4	1.530	389.3	369.1	412.5	412.5	1.537
7.000	73.535	11.577	768.7	-207.28	1.015	372.9	24.3	1.790	378.0	373.7	416.8	416.8	1.631
8.000	90.112	11.080	722.2	-211.61	1.012	377.2	22.7	2.047	378.0	374.0	419.9	419.9	1.683
9.000	107.879	9.278	680.7	-218.48	1.010	381.1	21.2	2.301	377.6	374.0	421.8	421.8	1.683
10.000	126.952	7.877	656.4	-217.44	1.009	384.4	20.2	2.547	377.6	374.0	424.0	424.0	1.683
11.000	146.791	6.812	635.1	-220.31	1.008	387.3	19.3	2.836	371.1	373.9	425.9	425.9	1.687
12.000	167.460	5.972	611.2	-223.27	1.007	409.7	18.5	3.103	372.5	373.5	427.5	427.5	1.676
13.000	189.273	5.297	584.2	-225.27	1.006	411.9	17.8	3.361	373.1	373.1	429.1	429.1	1.689
14.000	210.581	4.791	569.5	-226.79	1.006	413.9	17.1	3.639	373.1	373.1	430.5	430.5	1.689
15.000	232.106	4.398	553.1	-228.73	1.006	415.5	16.6	3.895	372.9	373.1	431.3	431.3	1.691
16.000	254.096	4.030	538.3	-230.23	1.005	416.1	16.1	4.091	372.5	373.5	432.5	432.5	1.695
17.000	277.270	3.781	524.8	-231.60	1.005	418.5	15.7	4.268	372.8	373.2	433.2	433.2	1.699
18.000	300.462	3.547	512.5	-232.66	1.005	419.8	15.2	4.436	372.8	373.2	434.3	434.3	1.699
19.000	321.710	3.319	500.6	-233.62	1.005	421.0	14.8	4.598	372.8	373.2	435.2	435.2	1.700
20.000	350.293	3.100	490.2	-235.10	1.004	422.1	14.5	4.746	372.7	373.3	435.9	435.9	1.700
21.000	386.479	2.887	480.3	-236.10	1.004	423.2	14.2	4.891	372.7	373.6	436.6	436.6	1.711
22.000	418.816	2.676	471.1	-237.03	1.004	424.1	13.9	5.040	372.6	373.6	437.3	437.3	1.714
23.000	450.952	2.482	462.5	-237.95	1.004	425.0	13.6	5.188	372.5	373.6	438.0	438.0	1.717
24.000	482.963	2.297	454.0	-238.79	1.004	425.9	13.3	5.335	372.5	373.6	438.7	438.7	1.720
25.000	514.947	2.120	445.5	-239.56	1.004	426.8	13.1	5.481	372.4	373.6	439.4	439.4	1.723
26.000	546.906	1.950	437.0	-240.27	1.003	427.6	12.8	5.625	372.4	373.6	440.1	440.1	1.726
27.000	578.840	1.786	428.5	-240.93	1.003	428.4	12.6	5.769	372.3	373.6	440.8	440.8	1.729
28.000	610.750	1.629	420.0	-241.55	1.003	429.2	12.4	5.911	372.3	373.6	441.5	441.5	1.732
29.000	642.637	1.478	411.5	-242.13	1.003	429.9	12.2	6.053	372.2	373.6	442.2	442.2	1.735
30.000	674.500	1.330	403.0	-242.67	1.003	430.6	12.0	6.194	372.2	373.6	442.9	442.9	1.738
31.000	706.340	1.185	394.5	-243.18	1.002	431.3	11.9	6.335	372.1	373.6	443.6	443.6	1.741
32.000	738.157	1.043	386.0	-243.66	1.002	432.0	11.7	6.475	372.1	373.6	444.3	444.3	1.744
33.000	770.000	0.903	377.5	-244.10	1.002	432.6	11.5	6.615	372.0	373.6	445.0	445.0	1.747
34.000	801.840	0.764	369.0	-244.51	1.002	433.2	11.4	6.756	372.0	373.6	445.7	445.7	1.750
35.000	833.657	0.626	360.5	-244.89	1.001	433.8	11.2	6.895	371.9	373.6	446.4	446.4	1.753
36.000	865.440	0.488	352.0	-245.24	1.001	434.3	11.0	7.035	371.9	373.6	447.1	447.1	1.756
37.000	897.200	0.350	343.5	-245.56	1.001	434.9	10.8	7.174	371.8	373.6	447.8	447.8	1.759
38.000	928.920	0.212	335.0	-245.85	1.000	435.4	10.7	7.313	371.8	373.6	448.5	448.5	1.762
39.000	960.620	0.075	326.5	-246.11	1.000	435.9	10.6	7.452	371.7	373.6	449.2	449.2	1.765
40.000	992.300	0.000	318.0	-246.34	1.000	436.4	10.4	7.591	371.7	373.6	449.9	449.9	1.768
41.000	1023.960	-0.138	309.5	-246.54	1.000	436.9	10.3	7.730	371.6	373.6	450.6	450.6	1.771
42.000	1055.600	-0.275	301.0	-246.71	1.000	437.4	10.2	7.869	371.6	373.6	451.3	451.3	1.774
43.000	1087.220	-0.412	292.5	-246.85	1.000	437.9	10.2	8.008	371.5	373.6	452.0	452.0	1.777
44.000	1118.820	-0.549	284.0	-246.96	1.000	438.4	10.1	8.147	371.5	373.6	452.7	452.7	1.780
45.000	1150.400	-0.686	275.5	-247.05	1.000	438.9	10.0	8.286	371.4	373.6	453.4	453.4	1.783
46.000	1181.960	-0.823	267.0	-247.12	1.000	439.4	9.9	8.425	371.4	373.6	454.1	454.1	1.786
47.000	1213.500	-0.959	258.5	-247.18	1.000	439.9	9.8	8.564	371.3	373.6	454.8	454.8	1.789
48.000	1245.000	-1.096	250.0	-247.22	1.000	440.4	9.7	8.703	371.3	373.6	455.5	455.5	1.792
49.000	1276.500	-1.233	241.5	-247.25	1.000	440.9	9.6	8.842	371.2	373.6	456.2	456.2	1.795
50.000	1308.000	-1.370	233.0	-247.27	1.000	441.4	9.5	8.981	371.2	373.6	456.9	456.9	1.798
51.000	1339.500	-1.507	224.5	-247.28	1.000	441.9	9.4	9.120	371.1	373.6	457.6	457.6	1.801
52.000	1371.000	-1.644	216.0	-247.28	1.000	442.4	9.3	9.259	371.1	373.6	458.3	458.3	1.804
53.000	1402.500	-1.781	207.5	-247.27	1.000	442.9	9.2	9.398	371.0	373.6	459.0	459.0	1.807
54.000	1434.000	-1.918	199.0	-247.25	1.000	443.4	9.1	9.537	371.0	373.6	459.7	459.7	1.810
55.000	1465.500	-2.055	190.5	-247.22	1.000	443.9	9.0	9.676	370.9	373.6	460.4	460.4	1.813
56.000	1497.000	-2.192	182.0	-247.18	1.000	444.4	8.9	9.815	370.9	373.6	461.1	461.1	1.816
57.000	1528.500	-2.329	173.5	-247.13	1.000	444.9	8.8	9.954	370.8	373.6	461.8	461.8	1.819
58.000	1560.000	-2.466	165.0	-247.07	1.000	445.4	8.7	10.093	370.8	373.6	462.5	462.5	1.822
59.000	1591.500	-2.603	156.5	-247.00	1.000	445.9	8.6	10.232	370.7	373.6	463.2	463.2	1.825
60.000	1623.000	-2.740	148.0	-246.92	1.000	446.4	8.5	10.371	370.7	373.6	463.9	463.9	1.828
61.000	1654.500	-2.877	139.5	-246.83	1.000	446.9	8.4	10.510	370.6	373.6	464.6	464.6	1.831
62.000	1686.000	-3.014	131.0	-246.73	1.000	447.4	8.3	10.649	370.6	373.6	465.3	465.3	1.834
63.000	1717.500	-3.151	122.5	-246.62	1.000	447.9	8.2	10.788	370.5	373.6	466.0	466.0	1.837
64.000	1749.000	-3.288	114.0	-246.50	1.000	448.4	8.1	10.927	370.5	373.6	466.7	466.7	1.840
65.000	1780.500	-3.425	105.5	-246.37	1.000	448.9	8.0	11.066	370.4	373.6	467.4	467.4	1.843
66.000	1812.000	-3.562	97.0	-246.23	1.000	449.4	7.9	11.205	370.4	373.6	468.1	468.1	1.846
67.000	1843.500	-3.699	88.5	-246.08	1.000	449.9	7.8	11.344	370.3	373.6	468.8	468.8	1.849
68.000	1875.000	-3.836	80.0	-245.92	1.000	450.4	7.7	11.483	370.3	373.6	469.5	469.5	1.852
69.000	1906.500	-3.973	71.5	-245.75	1.000	450.9	7.6	11.622	370.2	373.6	470.2	470.2	1.855
70.000	1938.000	-4.110	63.0	-245.57	1.000	451.4	7.5	11.761	370.2	373.6	470.9	470.9	1.858
71.000	1969.500	-4.247	54.5	-245.39	1.000	451.9	7.4	11.900	370.1	373.6	471.6	471.6	1.861
72.000	2001.000	-4.384	46.0	-245.20	1.000	452.4	7.3	12.039	370.1	373.6	472.3	472.3	1.864
73.000	2032.500	-4.521	37.5	-245.00	1.000	452.9	7.2	12.178	370.0	373.6	473.0	473.0	1.867
74.000	2064.000	-4.658	29.0	-244.79	1.000	453.4	7.1	12.317	369.9	373.6	473.7	473.7	1.870
75.000	2095.500	-4.795	20.5	-244.57	1.000	453.9	7.0	12.456	369.9	373.6	474.4	474.4	1.873
76.000	2127.000	-4.932	12.0	-244.35	1.000	454.4	6.9	12.595	369.8	373.6	475.1	475.1	1.876
77.000	2158.500	-5.069	3.5	-244.12	1.000	454.9	6.8	12.734	369.8	373.6	475.8	475.8	1.879
78.000	2190.000	-5.206	-8.0	-243.88	1.000	455.4	6.7	12.873	369.7	373.6	476.5	476.5	1.882
79.000	2221.500	-5.343	-19.5	-243.63	1.000	455.9	6.6	13.012	369.7	373.6	477.2	477.2	1.885
80.000	2253.000	-5.480	-31.0	-243.37	1.000	456.4	6.5	13.151	369.6	373.6	477.9	477.9	1.888
81.000	2284.500	-5.617	-42.5	-243.10	1.000	456.9	6.4	13.290	369.6	373.6	478.6	478.6	1.891
82.000	2316.000	-5.754	-54.0	-242.82	1.000	457.4	6.3	13.429	369.5	373.6	479.3	479.3	1.894
83.000	2347.500	-5.891	-65.5	-242.53	1.000	457.9	6.2	13.568	369.5	373.6	480.0	480.0</	

PRESSURE PROFILE DATA												
SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA												
COMPONENT	TREF FORMULA		DENSITY		HEAT FORM		WT. 0/0					
	DEG K		GM/CC		(KCAL/FORM.WT.)							
	85.2 F2		1.51		-3.47		80.					
	20.4 H2		.071		-1.687		20.					
BULK DENSITY = .299 GM/CC												
MIXTURE RATIO = 4.000 LB OXIDIZER / LB OF FUEL												
PRESSURE PROFILE DATA												
CHAMBER ENTROPY 537.80 EU/100GMS												THROAT
CHAMBER												
FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100 562.6
TEMP, DEG K	2855.4	2304.0	1842.5	1458.3	1141.2	985.2	885.1	682.7	525.3	403.9	310.3	235.2 2478.6
ENTHALPY (-)	26.03	82.90	128.61	164.98	193.61	207.27	215.91	235.16	246.45	256.67	264.50	270.75 65.12
CP	1.0497	1.0108	.9479	.9232	.8836	.8679	.8592	.8463	.8422	.8400	.8347	.8286 1.0252
IMPUL OPT	222.43	298.72	347.68	381.81	397.07	406.43	424.49	437.89	447.92	455.47	461.39	464.42
IMPUL VAC	330.64	363.16	391.49	413.04	422.99	429.18	441.29	450.42	457.34	462.59	466.72	468.83
EPSILON	1.051	1.571	2.684	4.804	6.817	8.793	16.311	30.357	57.695	109.502	205.841	1.000
SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100 546.8
TEMP, DEG K	2855.4	2349.3	1892.0	1501.7	1177.7	1017.9	915.0	706.7	544.2	418.7	322.1	245.1 2519.6
ENTHALPY (-)	26.03	83.39	129.98	167.21	196.58	210.61	219.50	237.26	250.96	261.50	269.58	275.98 64.90
X BAR	12.084	12.037	12.027	12.026	12.026	12.026	12.026	12.026	12.026	12.026	12.026	12.026 12.048
N	12.084	12.037	12.027	12.026	12.026	12.026	12.026	12.026	12.026	12.026	12.026	12.026 12.048
CP	1.2658	1.0766	.9811	.9290	.8863	.8699	.8599	.8455	.8411	.8392	.8340	.8278 1.1297
IMPUL OPT	223.39	300.71	350.45	385.18	400.72	410.25	428.67	442.34	452.59	460.29	466.30	468.90
IMPUL VAC	332.84	366.13	395.00	416.97	427.12	433.44	445.81	455.13	462.21	467.57	471.76	473.60
EPSILON	1.053	1.582	2.706	4.849	6.886	8.886	16.498	30.925	58.413	110.999	209.417	1.000
COMPOSITION SHIFTING (MOL/100 GM)												
18.86 F	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-64.50 F+H	4.2102	4.2105	4.2105	4.2105	4.2105	4.2105	4.2105	4.2105	4.2105	4.2105	4.2105	4.2105
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.1158	.0231	.0022	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0433
.00 H2	7.7577	7.8039	7.8143	7.8153	7.8154	7.8154	7.8154	7.8154	7.8154	7.8154	7.8154	7.7937

SYSTEM LIQUID DIPROPELLANT PC 1000, PSIA

COMPONENT	TREF FORMULA	DENSITY	HEAT FORM	WT. 0/0
	DEG K	GM/CC	(KCAL/FORM.WT.1	
85.2 F2		1.51	-5.47	85.
20.4 N2		0.81	-1.087	20.

FROZEN EXPANSION

C STAR = 8326.5 FT/SEC													
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/ I	OPT	DEL VAC	DEL VAC	I SEA	I AT	I AT	I VAC	CF SEA CF VAC
			DEG K	KCAL/1000GM	GM DEG		/P	/P	LVL	10000	50000	LVL	LVL
1.000	1.000	1000.000	2855.4	-26.05	1.050								
1.000	1.043	542.642	2478.6	-65.12	1.025	184.4	140.4	259	321.0	322.2	324.4	324.8	1.255
2.000	1.007	94.281	1046.0	-147.49	.946	325.9	51.6	.548	369.5	371.9	374.6	377.4	1.459
3.000	10.234	51.900	1390.6	-171.20	.915	355.4	40.8	.785	388.7	388.2	394.9	396.2	1.531
4.000	30.441	32.614	1231.9	-185.55	.895	372.6	34.5	1.057	391.5	396.2	405.3	407.1	1.533
5.000	42.404	23.583	1122.2	-195.29	.882	383.7	30.5	1.295	395.2	401.0	412.1	414.3	1.601
6.000	56.213	17.790	1039.5	-202.55	.873	391.9	27.7	1.557	394.7	403.6	416.9	419.6	1.622
7.000	70.874	14.110	974.3	-208.22	.867	398.1	25.4	1.812	405.1	420.4	423.7	423.7	1.637
8.000	86.484	11.515	921.0	-212.82	.862	403.1	23.9	2.073	405.7	425.4	427.0	427.0	1.650
9.000	103.485	9.488	874.5	-216.05	.859	407.2	22.5	2.350		425.7	429.7		1.661
10.000	121.913	8.203	838.5	-219.92	.856	410.7	21.3	2.600		427.6	432.0		1.670
11.000	141.146	7.085	805.5	-222.73	.853	413.7	20.3	2.870		429.1	436.0		1.677
12.000	161.130	6.206	774.6	-225.20	.851	416.3	19.5	3.139		430.4	439.7		1.684
13.000	181.849	5.505	750.9	-227.39	.850	418.5	18.7	3.403		431.5	443.3		1.690
14.000	202.507	4.938	727.9	-229.34	.849	420.6	18.1	3.660		432.4	446.4		1.695
15.000	223.542	4.473	707.1	-231.10	.847	422.4	17.5	3.909		433.2	449.9		1.700
16.000	244.635	4.088	688.2	-232.70	.847	424.0	17.0	4.148		433.9	451.0		1.704
17.000	267.915	3.733	670.9	-234.16	.846	425.5	16.5	4.373		434.5	452.0		1.708
18.000	292.831	3.415	655.1	-235.50	.845	426.9	16.0	4.589		435.0	452.9		1.712
19.000	318.422	3.140	640.4	-236.74	.845	428.1	15.6	4.794		435.3	453.8		1.715
20.000	344.581	2.902	626.8	-237.89	.844	429.3	15.2	5.254		435.6	454.6		1.718
21.000	371.199	2.694	614.1	-238.96	.844	430.4	14.9	5.531		435.9	455.3		1.721
22.000	398.167	2.512	602.3	-239.94	.844	431.4	14.6	5.805		436.1	456.0		1.724
23.000	425.383	2.351	591.2	-240.90	.843	432.3	14.3	6.075		436.3	456.6		1.726
24.000	452.751	2.209	580.8	-241.77	.843	433.2	14.0	6.339		436.4	457.2		1.729
25.000	480.181	2.083	571.0	-242.60	.843	434.1	13.7	6.597		436.5	457.8		1.731
26.000	507.549	1.970	561.7	-243.38	.843	434.9	13.5	6.849		436.6	458.3		1.733
27.000	534.980	1.867	553.2	-244.12	.843	435.6	13.3	7.095		436.7	458.8		1.735
28.000	562.154	1.779	544.7	-244.81	.843	436.3	13.0	7.331		436.8	459.3		1.737
29.000	589.203	1.697	536.8	-245.44	.842	436.9	12.8	7.561		436.9	459.8		1.738
30.000	616.066	1.623	529.5	-246.11	.842	437.6	12.6	7.785		437.0	460.2		1.740
31.000	645.078	1.550	522.1	-246.71	.842	438.2	12.4	8.003		437.1	460.6		1.742
32.000	677.226	1.477	515.3	-247.29	.842	438.7	12.3	8.309		437.2	461.0		1.743
33.000	709.969	1.409	508.7	-247.84	.842	439.3	12.1	8.589		437.3	461.4		1.745
34.000	743.140	1.346	502.5	-248.37	.842	439.8	11.9	8.849		437.4	461.7		1.746
35.000	776.821	1.287	496.5	-248.88	.842	440.3	11.8	9.149		437.5	462.1		1.747
36.000	810.895	1.233	490.7	-249.34	.842	440.8	11.6	9.429		437.6	462.4		1.749
37.000	845.341	1.183	485.1	-249.83	.842	441.2	11.5	9.708		437.7	462.7		1.750
38.000	880.122	1.136	479.8	-250.28	.841	441.7	11.3	9.986		437.8	463.0		1.751
39.000	915.199	1.093	474.7	-250.71	.841	442.1	11.2	10.263		437.9	463.3		1.752
40.000	950.545	1.052	469.7	-251.11	.841	442.5	11.1	10.538		438.0	463.6		1.753
41.000	986.087	1.014	464.9	-251.53	.841	442.9	11.0	10.812		438.1	463.9		1.754
42.000	1021.824	.979	460.1	-251.92	.841	443.3	10.9	11.085		438.2	464.1		1.755
43.000	1057.710	.945	455.9	-252.29	.841	443.7	10.7	11.351		438.3	464.4		1.756
44.000	1093.709	.914	451.6	-252.63	.841	444.0	10.6	11.618		438.4	464.6		1.757
45.000	1129.791	.885	447.4	-252.95	.841	444.4	10.5	11.881		438.5	464.9		1.758
46.000	1165.924	.858	443.4	-253.35	.841	444.7	10.4	12.141		438.6	465.1		1.759
47.000	1202.081	.832	439.4	-253.68	.841	445.0	10.3	12.398		438.7	465.3		1.760
48.000	1238.235	.808	435.4	-253.99	.841	445.3	10.2	12.652		438.8	465.5		1.761
49.000	1274.342	.785	432.0	-254.31	.841	445.6	10.1	12.902		438.9	465.8		1.761
50.000	1310.441	.763	428.4	-254.61	.841	445.9	10.0	13.149		439.0	466.0		1.762
6.817	68.046	14.696	985.2	-207.27	.848	397.1	25.9	1.744	397.1	400.9	420.0	423.0	1.535

SHIFTING EXPANSION

C STAR = 8395.9 FT/SEC													
EPSILON	PC/P	P PSIA	TEMP DEG K	ENTHALPY KCAL/1000G	CP CAL/ I GM DEG	I OPT	DEL VAC LVL	DEL VAC /P	I SEA	I AT 10000	I AT 50000	I VAC	CF SEA CF VAC LVL
1.000	1.000	1000.000	2855.4	-26.05	1.204								
1.000	1.829	546.824	2519.4	-64.90	1.130	183.9	142.7	261	322.8	325.9	326.2	326.4	1.237
2.000	10.434	95.842	1499.5	-144.71	.952	327.6	52.6	.551	372.3	374.7	379.5	380.4	1.458
3.000	18.962	52.738	1837.7	-175.12	.920	357.4	41.7	.797	387.9	391.4	398.7	399.5	1.486
4.000	30.249	35.059	1275.5	-187.88	.898	375.5	35.2	1.046	394.9	399.6	406.7	410.6	1.513
5.000	41.777	25.937	1162.9	-197.00	.885	386.7	31.3	1.306	398.7	404.5	415.7	417.9	1.528
6.000	55.381	18.057	1077.9	-205.37	.874	395.0	28.4	1.571	400.3	407.2	420.7	423.4	1.534
7.000	69.783	14.350	1010.9	-211.22	.869	401.4	26.2	1.827	408.8	424.4	427.6	427.6	1.638
8.000	85.408	11.494	954.1	-215.90	.864	406.9	24.5	2.084	409.5	427.4	430.5	430.5	1.651
9.000	101.977	9.408	910.2	-219.92	.860	410.7	23.0	2.350		429.7	435.7		1.662
10.000	119.914	8.339	871.0	-223.29	.856	414.2	21.9	2.621		431.6	438.1		1.671
11.000	138.813	7.204	837.0	-226.20	.854	417.3	20.8	2.894		433.2	438.1		1.679
12.000	158.448	6.310	807.1	-228.75	.851	419.9	20.0	3.165		434.5	439.9		1.686
13.000	178.472	5.597	780.5	-231.00	.850	422.3	19.2	3.432		435.6	441.5		1.692
14.000	199.233	5.019	756.8	-233.02	.848	424.3	18.5	3.693		436.6	442.9		1.697
15.000	219.989	4.544	735.3	-234.84	.847	426.2	17.9	3.945		437.4	444.1		1.702
16.000	240.818	4.153	715.6	-236.49	.846	427.9	17.4	4.188		438.1	445.3		1.706
17.000	263.185	3.800	697.9	-238.01	.845	429.4	16.9	4.447		438.7	446.3		1.710
18.000	287.641	3.477	681.5	-239.40	.844	430.8	16.4	4.729		439.2	447.3		1.714
19.000	312.774	3.197	666.1	-240.68	.844	432.1	16.0	5.013		439.6	448.2		1.717
20.000	338.487	2.954	652.2	-241.87	.843	433.3	15.6	5.295		439.9	449.0		1.720
21.000	364.839	2.742	639.0	-242.98	.843	434.4	15.3	5.575		440.2	449.7		1.722
22.000	391.220	2.556	626.8	-244.01	.843	435.4	15.0	5.852		440.4	450.4		1.724
23.000	418.058	2.392	615.3	-244.98	.842	436.4	14.7	6.125		440.6	451.1		1.729
24.000	445.028	2.247	604.5	-245.89	.842	437.3	14.4	6.393		440.8	451.7		1.731
25.000	472.106	2.118	594.4	-246.74	.842	438.2	14.1	6.655		440.9	452.3		1.733
26.000	499.192	2.003	584.8	-247.55	.842	439.0	13.8	6.911		441.0	452.8		1.735
27.000	526.223	1.900	575.7	-248.31	.842	439.7	13.6	7.180		441.1	453.3		1.737
28.000	553.146	1.808	567.1	-249.04	.841	440.5	13.4	7.402		441.2	453.9		1.739
29.000	579.921	1.724	558.9	-249.72	.841	441.1	13.2	7.637		441.3	454.3		1.741
30.000	606.522	1.649	551.1	-250.38	.841	441.8	13.0	7.865		441.4	454.7		1.743
31.000	633.311	1.579	543.7	-251.00	.841	442.4	12.8	8.091		441.5	455.2		1.746
32.000	660.698	1.508	536.5	-251.60	.841	443.0	12.6	8.372		441.6	455.6		1.748
33.000	687.910	1.437	529.2	-252.17	.841	443.7	12.4	8.653		441.7	456.0		1.750
34.000	729.612	1.371	523.2	-252.72	.841	444.1	12.2	8.937		441.8	456.3		1.759
35.000	762.668	1.311	517.0	-253.26	.841	444.6	12.0	9.219		441.9	456.7		1.750
36.000	796.140	1.256	511.0	-253.75	.841	445.1	11.9	9.502		442.0	457.0		1.751
37.000	829.993	1.204	505.2	-254.23	.841	445.5	11.8	9.783		442.1	457.3		1.752
38.000	864.188	1.157	499.7	-254.70	.840	446.0	11.6	10.064		442.2	457.7		1.754
39.000	898.689	1.113	494.6	-255.15	.840	446.4	11.5	10.344		442.3	458.0		1.755
40.000	933.457	1.071	489.2	-255.58	.840	446.9	11.4	10.623		442.4	458.2		1.756
41.000	968.450	1.030	484.0	-256.00	.840	447.3	11.3	10.905		442.5	458.5		1.757
42.000	1003.659	.994	478.5	-256.40	.840	447.7	11.1	11.174		442.6	458.9		1.758
43.000	1039.011	.962	474.9	-256.79	.840	448.0	11.0	11.444		442.7	459.1		1.759
44.000	1074.497	.931	470.6	-257.16	.840	448.4	10.9	11.714		442.8	459.3		1.760
45.000	1110.079	.900	466.0	-257.53	.840	448.8	10.8	11.983		442.9	459.6		1.761
46.000	1145.724	.870	461.7	-257.89	.840	449.1	10.7	12.252		443.0	459.8		1.762
47.000	1181.412	.844	457.8	-258.22	.840	449.4	10.6	12.500		443.0	460.0		1.763
48.000	1217.100	.827	453.6	-258.53	.840	449.8	10.5	12.746		443.0	460.2		1.764
49.000	1252.791	.798	450.0	-258.87	.840	450.1	10.4	13.021		443.1	460.5		1.765
50.000	1288.483	.769	446.1	-259.19	.840	450.4	10.3	13.295		443.1	460.7		1.766
6.866	68.046	14.690	1017.9	-210.61	.870	400.7	26.4	1.797	400.7	408.7	424.1	427.1	1.556

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA

COMPONENT	TREF FORMULA	DENSITY	HEAT FORM	WT. O/O
DEG K		GM/CC	(KCAL/FORM.WT.)	
85.2 F2		1.51	-3.47	85.
20.4 H2		0.071	-1.887	15.

BULK DENSITY = .374 GM/CC
MIXTURE RATIO = 5.667 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 466.63 EU/100GMS

	CHAMBER												THROAT	
	FROZEN EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	543.5	
TEMP, DEG K	3439.7	2782.9	2234.9	1778.8	1401.0	1212.8	1091.3	842.9	647.9	497.0	381.1	291.6	2991.8	
ENTHALPY (-)	21.80	77.98	123.29	159.52	188.21	201.98	210.69	228.13	241.56	251.87	259.77	265.84	60.31	
CP	.8687	.8415	.8103	.7763	.7409	.7223	.7118	.6934	.6847	.6828	.6804	.6766	.8506	
IMPUL OPT		221.07	297.13	346.12	380.47	395.90	405.35	423.65	437.23	447.36	454.98	460.75	183.02	
IMPUL VAC		328.79	361.49	390.10	411.98	422.11	428.39	440.68	449.90	456.87	462.15	466.17	322.90	
EPSILON		1.051	1.578	2.708	4.874	6.931	8.951	16.617	31.085	58.541	110.877	210.434	1.000	
	SHIFTING EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	557.6	
TEMP, DEG K	3439.7	2941.1	2454.3	1992.4	1587.0	1381.9	1248.0	971.5	751.0	578.6	445.1	342.6	3121.9	
ENTHALPY (-)	21.80	79.17	127.20	166.55	198.15	213.44	223.17	242.74	257.92	269.63	278.66	285.57	59.28	
X BAR	9.898	9.767	9.699	9.680	9.677	9.677	9.677	9.677	9.677	9.677	9.677	9.677	9.807	
N	9.898	9.767	9.699	9.680	9.677	9.677	9.677	9.677	9.677	9.677	9.677	9.677	9.807	
CP	1.4434	1.1613	.9319	.8095	.7571	.7340	.7202	.6961	.6825	.6767	.6757	.6721	1.2635	
IMPUL OPT		223.39	302.79	354.85	391.67	408.30	418.53	438.40	453.21	464.31	472.69	479.01	180.55	
IMPUL VAC		334.55	370.76	401.84	425.57	436.61	443.48	456.94	467.07	474.74	480.57	484.99	327.15	
EPSILON		1.062	1.631	2.832	5.133	7.328	9.488	17.712	33.270	62.840	119.276	227.597	1.000	
	COMPOSITION SHIFTING (MOL/100 GM)													
18.86 F	.0054	.0010	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0020	
-64.50 F+H	4.4683	4.4727	4.4736	4.4737	4.4737	4.4737	4.4737	4.4737	4.4737	4.4737	4.4737	4.4737	4.4717	
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
52.10 H	.4357	.1775	.0440	.0053	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.2580	
.00 H2	4.9885	5.1154	5.1817	5.2010	5.2035	5.2036	5.2036	5.2036	5.2036	5.2036	5.2036	5.2036	5.0756	

SYSTEM LIQUID BIPROPELLANT										PC 1000, PSIA									
COMPONENT										DENSITY /									
REF. FORMULA										HEAT FORM									
DEG. K										BTU/LB.									
85.2 F2										1.51									
20.4 M2										0.071									
										-1.007									
										85.									
										15.									
</																			

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 85.2 F2 1.51 -3.47 89.
 20.4 H2 0.071 -1.887 11.

BULK DENSITY = .468 GM/CC
 MIXTURE RATIO = 8.091 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 405.19 EU/100GMS

	CHAMBER												THROAT
	FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	543.0
TEMP, DEG K	3973.1	3204.9	2568.5	2042.7	1609.1	1393.5	1253.8	967.2	740.9	565.7	431.5	329.3	3447.9
ENTHALPY (-)	18.42	72.44	115.88	150.57	178.03	191.21	199.56	216.25	229.08	238.89	246.38	252.07	55.52
CP	.7124	.6931	.6714	.6461	.6191	.6031	.5922	.5730	.5624	.5585	.5575	.5554	.6997
IMPUL OPT		216.76	291.17	339.05	372.61	387.70	396.96	414.84	428.08	437.93	445.31	450.83	179.63
IMPUL VAC		322.23	354.09	382.02	403.42	413.33	419.48	431.47	440.42	447.15	452.22	456.04	316.54
EPSILON		1.051	1.574	2.701	4.863	6.918	8.934	16.566	30.893	57.917	109.118	206.633	1.000
	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	562.3
TEMP, DEG K	3973.1	3484.9	3025.5	2570.4	2115.3	1863.7	1694.9	1337.6	1044.0	808.3	623.0	479.4	3663.2
ENTHALPY (-)	18.42	74.05	121.65	162.01	195.52	212.04	222.66	244.22	261.14	274.30	284.46	292.29	54.20
X BAR	8.251	8.067	7.926	7.839	7.805	7.800	7.799	7.798	7.798	7.798	7.798	7.798	8.131
N	8.251	8.067	7.926	7.839	7.805	7.800	7.799	7.798	7.798	7.798	7.798	7.798	8.131
CP	1.62C1	1.3822	1.1082	.8497	.6860	.6402	.6198	.5880	.5658	.5517	.5462	.5449	1.4771
IMPUL OPT		219.98	299.66	353.42	392.50	410.40	421.50	443.19	459.50	471.79	481.07	488.09	176.41
IMPUL VAC		330.46	368.84	402.71	428.86	441.02	448.61	463.54	474.82	483.34	489.80	494.72	322.38
EPSILON		1.069	1.681	3.009	5.576	8.026	10.442	19.687	37.226	70.513	133.892	255.042	1.000
	COMPOSITION SHIFTING (MOL/100 GM)												
18.86 F	.0385	.0126	.0029	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0197
-64.50 F+H	4.6457	4.6716	4.6813	4.6839	4.6842	4.6842	4.6842	4.6842	4.6842	4.6842	4.6842	4.6842	4.6645
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.8660	.5239	.2518	.0802	.0128	.0029	.0008	.0000	.0000	.0000	.0000	.0000	.6457
.00 H2	2.7005	2.8586	2.9898	3.0743	3.1078	3.1128	3.1138	3.1142	3.1142	3.1142	3.1142	3.1142	2.8013

[illegible]

SYSTEM LIQUID BI-PROPELLANT PC 1000. PSIA

COMPONENT	TREF FORMULA	DENSITY	HEAT FORM	WT. O/O
DEG K		GM/CC	(KCAL/FORM.WT.)	
85.2 F2		1.51	-3.47	95.
20.4 H2		0.071	-1.887	5.

BULK DENSITY = .750 GM/CC
MIXTURE RATIO = 19.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 300.44 EU/100GMS

	CHAMBER											THROAT
	FROZEN EXPANSION											
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100 540.5
TEMP, DEG K	4893.7	3883.9	3067.8	2408.2	1875.8	1615.0	1447.2	1105.3	837.3	631.6	475.9	359.1 4195.8
ENTHALPY (-)	13.36	59.60	96.21	125.05	147.61	158.33	165.10	178.53	188.75	196.47	202.30	206.67 45.41
CP	.4619	.4533	.4431	.4305	.4160	.4066	.3997	.3859	.3770	.3740	.3742	.3745 .4561
IMPUL OPT		200.56	268.46	311.70	341.74	355.13	363.33	379.06	390.61	399.12	405.42	410.08 166.99
IMPUL VAC		297.32	325.56	350.31	369.17	377.85	383.23	393.63	401.32	407.03	411.28	414.46 292.54
EPSILON		1.046	1.551	2.634	4.701	6.657	8.569	15.756	29.095	53.955	100.526	188.366 1.000
	SHIFTING EXPANSION											
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100 570.1
TEMP, DEG K	4893.7	4447.3	4051.8	3689.6	3342.1	3137.0	2983.7	2570.4	2086.0	1659.5	1306.7	1018.5 4614.3
ENTHALPY (-)	13.36	61.91	104.71	142.62	176.18	193.87	205.76	231.41	252.72	269.80	283.32	293.91 43.71
X BAR	5.780	5.592	5.425	5.279	5.156	5.097	5.062	5.008	5.000	5.000	5.000	5.000 5.663
N	5.780	5.592	5.425	5.279	5.156	5.097	5.062	5.008	5.000	5.000	5.000	5.000 5.663
CP	2.1157	2.0123	1.8175	1.5508	1.2218	1.0131	.8606	.5293	.4089	.3915	.3746	.3620 2.0612
IMPUL OPT		205.51	281.90	335.33	376.35	396.27	409.11	435.53	456.31	472.31	484.61	494.02 162.49
IMPUL VAC		310.13	349.32	385.55	415.93	431.16	441.03	461.08	476.07	487.50	496.26	502.93 301.52
EPSILON		1.078	1.744	3.264	6.462	9.734	13.087	26.320	51.129	98.707	190.280	365.450 1.000
	COMPOSITION SHIFTING (MOL/100 GM)											
18.86 F	.9662	.7422	.5443	.3722	.2275	.1575	.1152	.0494	.0397	.0397	.0397	.0394 .8265
-64.50 F+H	4.0335	4.2577	4.4556	4.6278	4.7725	4.8425	4.8848	4.9507	4.9603	4.9603	4.9603	4.9603 4.1734
.00 F2	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001 .0001
52.10 H	.6331	.4823	.3462	.2261	.1247	.0764	.0479	.0061	.0000	.0000	.0000	.0000 .5394
.00 H2	.1468	.1102	.0792	.0532	.0316	.0207	.0138	.0018	.0000	.0000	.0000	.0000 .1238

SYSTEM LIQUID SHIPWRECK										PC 1000, PSIA		WT. 0.70		
COMPONENT TREF FORMULA										DENSITY	HEAT FORM			
DEG. K										GM/CC	(KCAL/FORM.WT.)			
85.2 F2										1.51	-3.47	95.		
70.4 F2										0.071	-1.887	5.		
C STAR = 7473.1 F/SEC														
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/G	I OPT	DELTA V	DELTA V	I SHA	I AT	I AT	I VAC	CF SEA	CF VAC
			DEG K	KCAL/1000G	CM CAL/G		DELTA V	DELTA V	LVL	10000	00000			
1.000	1.000	1000.000	7.51	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11
1.000	1.850	940.496	419.58	-45.41	4.56	107.00	125.5	.232	289.1	290.2	292.1	292.5	1.245	1.259
1.000	10.979	91.083	2706.6	-112.14	3.37	294.0	45.0	.494	331.7	333.8	338.1	338.9	1.428	1.459
3.000	1.000	50.248	2274.6	-10.79	4.27	319.7	35.5	.706	344.8	347.9	356.0	355.2	1.484	1.529
3.000	11.664	31.581	2009.2	-142.04	4.20	334.6	29.9	.948	350.6	356.8	363.0	364.6	1.510	1.570
5.000	6.144	22.414	1865.4	-161.51	4.16	348.1	24.5	1.161	353.7	358.9	366.9	369.1	1.523	1.593
6.000	58.212	17.179	1689.0	-155.32	4.09	351.4	24.0	1.198	354.9	361.1	373.0	375.4	1.528	1.616
7.000	73.539	13.598	1508.0	-159.75	4.05	356.9	22.1	1.627	362.3	368.2	376.2	379.0	1.632	
8.000	50.252	11.887	1491.2	-163.14	4.02	361.2	20.6	1.660	362.7	378.7	381.8	384.4	1.644	
10.000	9.247	9.247	1416.5	-168.88	3.98	368.8	19.4	1.684	368.8	379.4	386.9	390.6	1.673	
10.000	127.155	7.864	1352.5	-168.88	3.98	367.8	18.4	2.336	367.8	382.2	386.2	390.6	1.644	
11.000	147.415	6.784	1296.8	-171.07	3.94	370.4	17.5	2.578	368.8	385.5	387.9	391.7	1.673	
12.000	168.471	5.936	1247.9	-173.00	3.92	372.7	16.7	2.818	368.6	384.6	387.4	391.6	1.676	
13.000	190.598	5.260	1204.3	-174.70	3.90	374.6	16.1	3.053	368.5	385.5	387.7	391.7	1.682	
14.000	212.917	4.715	1165.4	-176.22	3.88	376.4	15.5	3.280	368.3	386.3	387.7	391.7	1.693	
15.000	234.369	4.288	1129.9	-177.58	3.87	378.0	14.9	3.500	368.3	386.9	387.9	392.5	1.692	
16.000	257.362	3.886	1090.8	-178.83	3.86	379.4	14.5	3.721	368.3	387.5	389.9	393.9	1.696	
17.000	281.287	3.510	1068.3	-179.96	3.85	380.7	14.0	3.972	368.3	387.9	390.7	394.7	1.699	
18.000	305.125	3.175	1046.1	-181.01	3.83	381.8	13.5	4.221	368.3	388.3	391.5	395.5	1.703	
19.000	327.865	2.962	1016.0	-181.97	3.83	383.0	13.1	4.474	368.6	388.6	392.2	396.2	1.706	
20.000	348.464	2.735	982.2	-182.86	3.82	384.0	12.9	4.722	368.9	388.9	392.9	396.9	1.709	
21.000	366.255	2.536	951.1	-183.69	3.81	384.9	12.6	4.966	368.1	389.1	393.5	397.5	1.712	
22.000	423.278	2.361	900.8	-184.58	3.80	385.8	12.3	5.211	368.2	389.2	393.6	397.6	1.715	
23.000	473.467	2.210	871.1	-185.18	3.80	386.6	12.0	5.447	368.3	389.3	393.7	397.7	1.716	
24.000	511.739	2.076	814.0	-185.86	3.79	387.4	11.8	5.678	368.5	389.5	393.9	397.9	1.721	
25.000	551.172	1.956	817.2	-186.49	3.79	388.1	11.5	5.904	368.6	389.6	394.1	398.1	1.729	
26.000	590.572	1.850	841.3	-187.09	3.78	388.8	11.3	6.127	368.6	389.6	394.1	398.1	1.733	
27.000	629.955	1.759	865.1	-187.66	3.78	389.4	11.1	6.348	368.7	389.7	394.2	398.2	1.737	
28.000	559.115	1.669	852.1	-188.20	3.77	390.0	10.9	6.564	368.7	389.7	394.2	398.2	1.726	
29.000	628.161	1.592	818.6	-188.71	3.77	390.6	10.7	6.740	368.8	389.8	394.3	398.3	1.728	
30.000	672.281	1.510	829.7	-189.17	3.77	391.1	10.5	6.986	368.8	389.8	394.3	398.3	1.729	
31.000	717.125	1.435	812.5	-189.55	3.76	391.6	10.3	7.204	368.9	389.9	394.4	398.4	1.731	
32.000	732.784	1.365	811.8	-189.79	3.76	392.1	10.2	7.406	368.9	389.9	394.4	398.4	1.732	
33.000	769.225	1.305	795.5	-190.29	3.76	392.6	10.1	7.735	369.0	390.0	394.5	398.5	1.733	
34.000	805.769	1.241	779.9	-190.42	3.76	393.1	9.9	7.989	369.0	390.0	394.5	398.5	1.735	
35.000	842.313	1.183	764.8	-190.50	3.76	393.6	9.7	8.236	369.1	390.1	394.6	398.6	1.736	
36.000	878.751	1.131	749.8	-190.57	3.76	394.0	9.6	8.486	369.1	390.1	394.6	398.6	1.737	
37.000	918.845	1.084	750.4	-190.23	3.75	394.2	9.5	8.736	369.1	390.1	394.6	398.6	1.738	
38.000	957.220	1.045	743.1	-190.17	3.75	394.6	9.4	8.983	369.1	390.1	394.6	398.6	1.739	
39.000	985.466	1.004	737.5	-190.70	3.75	395.0	9.3	9.228	369.1	390.1	394.6	398.6	1.740	
40.000	1013.601	0.970	732.0	-191.01	3.75	395.3	9.2	9.471	369.1	390.1	394.6	398.6	1.741	
41.000	1040.415	0.931	716.0	-191.32	3.75	395.7	9.0	9.711	369.1	390.1	394.6	398.6	1.742	
42.000	1113.464	0.898	774.2	-191.61	3.75	396.0	8.9	9.947	369.1	390.1	394.6	398.6	1.743	
43.000	1152.476	0.867	77.36	-191.71	3.75	396.3	8.8	10.181	369.1	390.1	394.6	398.6	1.744	
44.000	1197.477	0.837	67.77	-191.76	3.75	396.6	8.7	10.414	369.1	390.1	394.6	398.6	1.745	
45.000	1232.734	0.812	66.22	-191.83	3.75	396.9	8.6	10.642	369.1	390.1	394.6	398.6	1.746	
46.000	1271.883	0.786	679.3	-191.63	3.75	397.2	8.5	10.867	369.1	390.1	394.6	398.6	1.747	
47.000	1311.143	0.763	672.7	-191.34	3.75	397.4	8.4	11.088	369.1	390.1	394.6	398.6	1.748	
48.000	1353.483	0.741	655.8	-191.18	3.75	397.6	8.3	11.309	369.1	390.1	394.6	398.6	1.749	
49.000	1395.443	0.718	669.0	-191.04	3.75	397.8	8.2	11.521	369.1	390.1	394.6	398.6	1.750	
50.000	1479.848	0.694	674.8	-190.94	3.75	398.2	8.2	11.732	369.1	390.1	394.6	398.6	1.751	
6.067	68.245	18.696	1615.0	-154.33	4.67	354.1	22.7	1.546	355.1	362.0	375.2	377.7	1.529	1.727
SHIFTING EXPANSION														
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/G	I OPT	DELTA V	DELTA V	I SHA	I AT	I AT	I VAC	CF SEA	CF VAC
			DEG K	KCAL/1000G	CM CAL/G		DELTA V	DELTA V	LVL	10000	00000			
1.000	1.000	1000.000	499.37	2.136	2.136	2.136	2.136	2.136	2.136	2.136	2.136	2.136	2.136	2.136
2.000	1.758	875.116	441.41	-43.71	2.361	167.5	139.0	.294	297.4	299.5	303.1	303.5	1.237	1.222
2.000	6.178	122.285	364.19	-116.11	1.781	276.9	61.5	.521	351.0	353.2	357.7	358.4	1.439	1.470
3.000	16.77	46.777	317.77	-137.16	1.545	304.8	49.4	.747	357.2	360.4	365.1	365.8	1.518	1.560
3.000	11.358	40.763	351.55	-131.32	1.556	306.0	46.4	.933	367.8	369.2	373.7	375.4	1.562	1.622
5.000	12.257	34.405	341.78	-176.42	1.349	362.5	42.4	1.244	367.1	372.6	375.3	375.4	1.661	1.663
5.000	36.461	27.411	318.4	-172.42	1.259	372.5	40.5	1.474	391.3	397.8	403.3	403.0	1.605	1.694
6.000	16.77	34.405	341.78	-176.42	1.349	362.5	42.4	1.244	367.1	372.6	375.3	375.4	1.661	1.663
6.000	47.473	19.411	325.88	-171.76	1.145	391.1	37.0	1.558	410.1	416.6	421.1	421.1	1.615	1.711
9.000	61.571	15.243	315.76	-171.41	1.53	392.7	35.7	2.123	346.1	351.6	358.6	358.4	1.621	1.739
10.000	70.524	14.194	315.33	-171.63	1.44	397.5	34.6	2.346	407.0	412.9	420.1	420.1	1.772	
11.000	79.486	13.215	315.46	-171.64	1.47	401.7	33.6	2.586	407.0	412.9	420.1	420.1	1.772	
12.000	88.448	12.236	315.59	-171.65	1.50	405.9	32.5	2.826	407.0	412.9	420.1	420.1	1.772	
13.000	97.410	11.258	315.72	-171.65	1.53	409.8	32.5	3.071	407.0	412.9	420.1	420.1	1.772	
14.000	106.372	10.279	315.85	-171.65	1.56	413.8	31.3	3.322	407.0	412.9	420.1	420.1	1.772	
15.000	115.334	9.299	315.97	-171.65	1.59	417.8	30.6	3.572	407.0	412.9	420.1	420.1	1.772	
16.000	124.296	8.319	316.10	-171.65	1.62	421.8	29.9	3.822	407.0	412.9	420.1	420.1	1.772	
17.000	133.258	7.339	316.22	-171.65	1.65	425.8	29.2	4.072	407.0	412.9	420.1	420.1	1.772	
18.000	142.220	6.359	316.35	-171.65	1.68	429.8	28.5	4.322	407.0	412.9	420.1	420.1	1.772	
19.000	151.182	5.379	316.47	-171.65	1.71	433.8	27.8	4.572	407.0	412.9	420.1	420.1	1.772	
20.000	160.144	4.399	316.60	-171.65	1.74	437.8	27.1	4.822	407.0	412.9	420.1	420.1	1.772	
21.000	169.106	3.419	316.72	-171.65	1.77	441.8	26.4	5.072	407.0	412.9	420.1	420.1	1.772	
22.000	178.068	2.439	316.85	-171.65	1.80	445.8	25.7	5.322	407.0	412.9	420.1	420.1	1.772	
23.000	187.030	1.459	316.97	-171.65	1.83	449.8	25.0	5.572	407.0	412.9	420.1	420.1	1.772	
24.000	195.992	0.479	317.10	-171.65	1.86	453.8	24.3	5.822	407.0	412.9	420.1	420.1	1.772	
25.000														

SYSTEM LIQUID BIPROPELLANT PC 300. PSIA

COMPONENT	TREE FORMULA	DENSITY	HEAT FORM	WT. O/O
DEG K		GM/CC	(KCAL/FORM.WT.)	
85.2 F2		1.51	-3.47	75.
20.4 H2		0.071	-1.887	25.

BULK DENSITY = .249 GM/CC

MIXTURE RATIO = 3.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 637.79 EU/100GMS

CHAMBER													THROAT
FROZEN EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	162.5
TEMP, DEG K	2341.9	1932.1	1581.8	1283.9	1088.0	1033.9	827.8	660.5	526.1	418.9	333.5	263.8	2022.6
ENTHALPY (-)	30.25	79.06	119.17	151.89	172.68	178.33	199.57	216.55	230.07	240.85	249.39	256.33	68.44
CP	1.2126	1.1677	1.1225	1.0752	1.0485	1.0421	1.0208	1.0091	1.0054	1.0033	.9977	.9909	1.1784
IMPUL OPT		206.06	278.12	325.29	352.00	358.91	383.79	402.57	416.93	428.03	436.62	443.47	182.26
IMPUL VAC		322.71	348.87	374.39	390.45	394.75	410.62	422.98	432.63	440.20	446.12	450.87	320.32
EPSILON		1.019	1.377	2.128	3.081	3.459	5.768	9.771	16.736	28.901	50.242	87.115	1.000
SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	162.8
TEMP, DEG K	2341.9	1943.8	1593.8	1294.4	1097.2	1042.8	835.2	666.5	531.1	422.8	336.8	266.5	2034.1
ENTHALPY (-)	30.25	79.20	119.54	152.49	173.43	179.12	200.53	217.64	231.27	242.15	250.76	257.74	68.43
X BAR	14.391	14.377	14.375	14.374	14.374	14.374	14.374	14.374	14.374	14.374	14.374	14.374	14.378
N	14.391	14.377	14.375	14.374	14.374	14.374	14.374	14.374	14.374	14.374	14.374	14.374	14.378
CP	1.3007	1.1861	1.1256	1.0766	1.0491	1.0426	1.0208	1.0090	1.0051	1.0032	.9972	.9908	1.2063
IMPUL OPT		206.36	278.71	326.09	352.92	359.87	384.87	403.74	418.18	429.34	437.97	444.86	182.26
IMPUL VAC		323.43	349.77	375.42	391.56	395.88	411.84	424.26	433.96	441.58	447.53	452.30	320.98
EPSILON		1.020	1.379	2.131	3.085	3.465	5.779	9.790	16.770	28.963	50.358	87.372	1.000
COMPOSITION SHIFTING (MOLE/100 GM)													
18.86 F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-64.50 F+H	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.0323	.0044	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0075
.00 H2	10.4110	10.4249	10.4270	10.4271	10.4271	10.4271	10.4271	10.4271	10.4271	10.4271	10.4271	10.4271	10.4234

SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
COMPONENT REF. FORMULA DENSITY HEAT FORM. WT. O/B
DEG. F GM/CC. (KCAL/FORM.WT.)
85.2 F2 1.51 -3.47 75.
20.4 M2 0.071 -1.887 75.

FROZEN EXPANSION																													
C STAR 812.2 F/150L														C STAR 812.2 F/150L															
EPSILON	PL/P	P PSIA	TEMP	ENTHALPY	CP CAL	I OPT	DELTA C	DELTA VAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC	EPSILON	PL/P	P PSIA	TEMP	ENTHALPY	CP CAL	I OPT	DELTA C	DELTA VAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC
			DEG. F	KCAL/100GM	GM DEG.				LVL	10000	50000		LVL																
1.000	1.000	100.000	2341.9	-30.25	1.213										1.000	1.000	100.000	2341.9	-30.25	1.213									
1.000	1.846	162.542	2022.6	-68.44	1.179	182.3	138.1	.849	307.8	311.6	316.9	320.3	1.208	1.257	1.000	1.846	162.542	2022.6	-68.44	1.179	182.3	138.1	.849	307.8	311.6	316.9	320.3	1.208	1.257
2.000	10.318	29.075	1317.9	-148.26	1.081	320.8	50.6	1.139	345.8	353.5	366.4	371.4	1.357	1.457	2.000	10.318	29.075	1317.9	-148.26	1.081	320.8	50.6	1.139	345.8	353.5	366.4	371.4	1.357	1.457
3.000	19.579	15.323	1100.8	-171.34	1.050	350.3	39.1	2.551	351.9	363.2	385.1	389.4	1.381	1.528	3.000	19.579	15.323	1100.8	-171.34	1.050	350.3	39.1	2.551	351.9	363.2	385.1	389.4	1.381	1.528
4.000	31.085	9.651	970.2	-184.94	1.035	366.8	32.9	3.408							4.000	31.085	9.651	970.2	-184.94	1.035	366.8	32.9	3.408						
5.000	44.154	6.788	840.5	-194.18	1.026	377.6	29.0	4.272							5.000	44.154	6.788	840.5	-194.18	1.026	377.6	29.0	4.272						
6.000	56.140	5.142	811.9	-200.99	1.020	385.4	26.3	5.104							6.000	56.140	5.142	811.9	-200.99	1.020	385.4	26.3	5.104						
7.000	74.495	4.027	761.6	-206.32	1.015	391.4	24.2	6.006							7.000	74.495	4.027	761.6	-206.32	1.015	391.4	24.2	6.006						
8.000	91.437	3.281	714.2	-210.61	1.012	396.1	22.6	6.881							8.000	91.437	3.281	714.2	-210.61	1.012	396.1	22.6	6.881						
9.000	108.678	2.760	664.0	-214.18	1.010	400.0	21.3	7.756							9.000	108.678	2.760	664.0	-214.18	1.010	400.0	21.3	7.756						
10.000	126.471	2.372	654.0	-217.20	1.009	403.3	20.2	8.605							10.000	126.471	2.372	654.0	-217.20	1.009	403.3	20.2	8.605						
11.000	146.044	2.045	624.0	-219.62	1.008	406.1	19.2	9.494							11.000	146.044	2.045	624.0	-219.62	1.008	406.1	19.2	9.494						
12.000	167.050	1.784	605.1	-222.11	1.007	408.5	18.4	10.297							12.000	167.050	1.784	605.1	-222.11	1.007	408.5	18.4	10.297						
13.000	189.157	1.586	585.1	-224.14	1.007	410.7	17.7	11.174							13.000	189.157	1.586	585.1	-224.14	1.007	410.7	17.7	11.174						
14.000	211.057	1.421	567.1	-225.95	1.006	412.6	17.1	12.024							14.000	211.057	1.421	567.1	-225.95	1.006	412.6	17.1	12.024						
15.000	233.180	1.287	555.9	-227.59	1.006	414.3	16.5	12.854							15.000	233.180	1.287	555.9	-227.59	1.006	414.3	16.5	12.854						
16.000	255.150	1.175	536.1	-229.07	1.004	415.9	16.0	13.649							16.000	255.150	1.175	536.1	-229.07	1.004	415.9	16.0	13.649						
17.000	276.223	1.078	522.7	-230.42	1.005	417.3	15.6	14.452							17.000	276.223	1.078	522.7	-230.42	1.005	417.3	15.6	14.452						
18.000	296.614	.986	510.3	-231.67	1.005	418.6	15.2	15.140							18.000	296.614	.986	510.3	-231.67	1.005	418.6	15.2	15.140						
19.000	316.673	.910	494.9	-232.82	1.005	419.8	14.8	15.744							19.000	316.673	.910	494.9	-232.82	1.005	419.8	14.8	15.744						
20.000	336.287	.842	484.2	-233.89	1.004	420.9	14.4	16.281							20.000	336.287	.842	484.2	-233.89	1.004	420.9	14.4	16.281						
21.000	355.467	.781	474.6	-234.88	1.004	421.9	14.1	16.757							21.000	355.467	.781	474.6	-234.88	1.004	421.9	14.1	16.757						
22.000	374.222	.730	465.2	-235.80	1.004	422.9	13.8	17.199							22.000	374.222	.730	465.2	-235.80	1.004	422.9	13.8	17.199						
23.000	392.588	.688	456.5	-236.67	1.004	423.8	13.5	17.607							23.000	392.588	.688	456.5	-236.67	1.004	423.8	13.5	17.607						
24.000	410.529	.643	448.2	-237.49	1.004	424.6	13.3	17.981							24.000	410.529	.643	448.2	-237.49	1.004	424.6	13.3	17.981						
25.000	428.041	.607	440.8	-238.25	1.004	425.4	13.2	18.324							25.000	428.041	.607	440.8	-238.25	1.004	425.4	13.2	18.324						
26.000	445.113	.574	433.6	-238.97	1.004	426.1	12.8	18.726							26.000	445.113	.574	433.6	-238.97	1.004	426.1	12.8	18.726						
27.000	461.713	.544	431.4	-239.65	1.004	426.8	12.6	19.088							27.000	461.713	.544	431.4	-239.65	1.004	426.8	12.6	19.088						
28.000	477.827	.516	424.4	-240.32	1.003	427.5	12.4	19.404							28.000	477.827	.516	424.4	-240.32	1.003	427.5	12.4	19.404						
29.000	493.242	.489	416.1	-240.91	1.003	428.1	12.2	19.681							29.000	493.242	.489	416.1	-240.91	1.003	428.1	12.2	19.681						
30.000	508.114	.463	407.6	-241.50	1.003	428.7	12.0	19.932							30.000	508.114	.463	407.6	-241.50	1.003	428.7	12.0	19.932						
31.000	522.255	.440	406.4	-242.05	1.003	429.2	11.8	20.142							31.000	522.255	.440	406.4	-242.05	1.003	429.2	11.8	20.142						
32.000	535.145	.425	401.6	-242.55	1.003	429.8	11.6	20.324							32.000	535.145	.425	401.6	-242.55	1.003	429.8	11.6	20.324						
33.000	547.826	.408	396.6	-243.07	1.002	430.3	11.5	20.471							33.000	547.826	.408	396.6	-243.07	1.002	430.3	11.5	20.471						
34.000	560.219	.395	391.7	-243.51	1.002	430.8	11.3	20.611							34.000	560.219	.395	391.7	-243.51	1.002	430.8	11.3	20.611						
35.000	572.347	.372	387.1	-243.94	1.002	431.3	11.2	20.704							35.000	572.347	.372	387.1	-243.94	1.002	431.3	11.2	20.704						
36.000	584.271	.357	382.6	-244.49	1.001	431.7	11.0	20.886							36.000	584.271	.357	382.6	-244.49	1.001	431.7	11.0	20.886						
37.000	595.957	.343	378.3	-244.92	1.001	432.1	10.9	21.068							37.000	595.957	.343	378.3	-244.92	1.001	432.1	10.9	21.068						
38.000	607.349	.331	374.2	-245.33	1.001	432.6	10.8	21.246							38.000	607.349	.331	374.2	-245.33	1.001	432.6	10.8	21.246						
39.000	618.507	.317	370.2	-245.73	1.001	433.0	10.6	21.409							39.000	618.507	.317	370.2	-245.73	1.001	433.0	10.6	21.409						
40.000	629.329	.306	366.4	-246.11	1.000	433.5	10.5	21.568							40.000	629.329	.306	366.4	-246.11	1.000	433.5	10.5	21.568						
41.000	639.757	.295	362.7	-246.48	1.000	434.0	10.4	21.727							41.000	639.757	.295	362.7	-246.48	1.000	434.0	10.4	21.727						
42.000	649.817	.285	358.1	-246.84	1.000	434.5	10.3	21.884							42.000	649.817	.285	358.1	-246.84	1.000	434.5	10.3	21.884						
43.000	659.448	.276	353.6	-247.19	.999	434.7	10.1	22.027							43.000	659.448	.276	353.6	-247.19	.999	434.7	10.1	22.027						
44.000	668.688	.267	349.1	-247.54	.999	435.1	10.0	22.168							44.000	668.688	.267	349.1	-247.54	.999	435.1	10.0	22.168						
45.000	677.568	.259	344.1	-247.84	.999	435.1	9.8	22.304							45.000	677.568	.259	344.1	-247.84	.999	435.1	9.8	22.304						
46.000	686.023	.251	339.4	-248.16	.999	435.	9.7	22.434							46.000	686.023	.251	339.4	-248.16	.999	435.	9.7	22.434						
47.000	694.155	.244	342.8	-248.46	.999	435.7	9.6	22.564							47.000	694.155	.244	342.8	-248.46	.999	435.7	9.6	22.564						
48.000	702.023	.237	337.1	-248.75	.998	436.2	9.5	22.694							48.000	702.023	.237	337.1	-248.75	.998	436.2	9.5	2						

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 300. PSIA

COMPONENT	REF FORMULA	DENSITY	HEAT FORM	WT. G/G
DEG K		GM/CC	(KCAL/FORM.WT.)	
85.2 F2		1.51	-3.47	80.
20.4 H2		0.071	-1.887	20.

BULK DENSITY = .299 GM/CC
MIXTURE RATIO = 4.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 566.75 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	162.9
TEMP, DEG K	2818.5	2337.9	1926.3	1575.1	1342.0	1277.0	1027.3	821.6	654.8	521.1	414.5	329.8	2445.4
ENTHALPY (-)	26.03	75.63	116.64	150.30	171.84	177.72	199.86	217.62	231.80	243.09	252.08	259.20	64.67
CP	1.0479	1.0143	.9773	.9399	.9088	.9007	.8733	.8555	.8462	.8432	.8415	.8371	1.0234
IMPUL OPT		207.73	280.76	328.79	356.16	363.26	388.87	408.25	423.09	434.54	443.45	450.37	183.36
IMPUL VAC		325.64	352.64	378.98	395.64	400.10	416.55	429.34	439.31	447.11	453.24	458.04	323.09
EPSILON		1.021	1.386	2.155	3.133	3.521	5.893	9.997	17.122	29.546	51.282	89.456	1.000
	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	165.4
TEMP, DEG K	2818.5	2404.4	2006.4	1649.4	1409.0	1341.8	1082.3	867.6	692.7	551.9	439.4	350.1	2509.8
ENTHALPY (-)	26.03	76.23	118.42	153.33	175.75	181.87	204.99	223.58	238.45	250.31	259.76	267.25	64.14
X BAR	12.119	12.052	12.030	12.026	12.026	12.026	12.026	12.026	12.026	12.026	12.026	12.026	12.064
N	12.119	12.052	12.030	12.026	12.026	12.026	12.026	12.026	12.026	12.026	12.026	12.026	12.064
CP	1.4037	1.1537	1.0135	.9484	.9157	.9068	.8763	.8560	.8452	.8406	.8397	.8358	1.2069
IMPUL OPT		208.98	283.51	332.78	360.89	368.20	394.56	414.55	429.87	441.70	450.92	458.08	182.09
IMPUL VAC		328.86	357.13	384.31	401.48	406.09	423.08	436.31	446.62	454.70	461.05	466.03	325.84
EPSILON		1.024	1.400	2.183	3.178	3.574	5.990	10.178	17.452	30.136	52.341	91.405	1.000
	COMPOSITION SHIFTING (MOL/100 GM)												
18.86 F	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-64.50 F+H	4.2100	4.2105	4.2105	4.2105	4.2105	4.2105	4.2105	4.2105	4.2105	4.2105	4.2105	4.2105	4.2104
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.1861	.0518	.0081	.0006	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0755
.00 H2	7.7226	7.7895	7.8113	7.8151	7.8153	7.8154	7.8154	7.8154	7.8154	7.8154	7.8154	7.8154	7.7777

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 300 PSIA

COMPONENT	TREF FORMULA	DENSITY	HEAT FORM	WT. O/O
	DEG K	GM/CC	(KCAL/FORM.WT.)	
85.2 F2		1.51	-3.47	85.
20.4 H2		0.071	-1.887	15.

BULK DENSITY = .374 GM/CC
 MIXTURE RATIO = 5.667 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 490.41 EU/100GMS

CHAMBER

THROAT

FROZEN EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100
TEMP, DEG K	3329.7	2764.2	2281.9	1871.1	1598.5	1522.4	1278.3	983.6	783.5	622.2	493.5	391.3
ENTHALPY (-)	21.80	70.08	110.06	142.96	164.06	169.84	191.62	209.12	223.10	234.22	243.05	250.04
CP	.8646	.8417	.8146	.7857	.7628	.7561	.7260	.7053	.6927	.6866	.6853	.6832
IMPUL OPT	204.93	277.08	324.64	351.78	358.85	384.35	403.67	418.46	429.86	438.70	445.58	450.52
IMPUL VAC	321.35	348.16	374.39	391.00	395.47	411.93	424.70	434.62	442.36	448.41	453.16	458.81
EPSILON	1.021	1.388	2.164	3.153	3.547	3.950	10.103	17.286	29.760	51.506	89.552	1.000

SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100
TEMP, DEG K	3329.7	2947.5	2564.8	2176.4	1887.6	1804.2	1474.5	1193.7	959.3	767.0	611.6	487.0
ENTHALPY (-)	21.80	71.26	114.17	150.79	174.79	181.40	206.59	227.07	243.59	256.83	267.40	275.82
X BAR	9.984	9.833	9.735	9.690	9.680	9.679	9.677	9.677	9.677	9.677	9.677	9.677
N	9.984	9.833	9.735	9.690	9.680	9.679	9.677	9.677	9.677	9.677	9.677	9.677
P	1.7114	1.3937	1.0924	.8844	.8025	.7874	.7442	.7146	.6947	.6831	.6774	.6763
IMPUL OPT	207.42	283.46	334.97	364.81	372.61	400.93	422.56	439.24	452.16	462.21	470.08	477.72
IMPUL VAC	328.22	359.61	389.40	408.11	411.12	431.70	446.20	457.51	466.35	473.28	478.74	484.35
EPSILON	1.031	1.447	2.303	3.386	3.817	4.456	11.043	19.015	32.890	57.130	99.618	1.000

COMPOSITION SHIFTING (MOL/100 GM)												
18.86 F	.0066	.0018	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0026
-64.50 F+H	4.4671	4.4719	4.4736	4.4737	4.4737	4.4737	4.4737	4.4737	4.4737	4.4737	4.4737	4.4711
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.6068	.3105	.1153	.0256	.0051	.0029	.0001	.0000	.0000	.0000	.0000	.3840
.00 H2	4.9035	5.0493	5.1461	5.1909	5.2011	5.2022	5.2036	5.2036	5.2036	5.2036	5.2036	5.0129

SYSTEM LIQUID BIPROPELLANT										PC 500 PSIA									
COMPONENT										DENSITY									
REF FORMULA										HEAT FORM									
DEG K										(KCAL/FORM.WT.1)									
25.2 E										1.51									
20.4 M2										-1.867									
										15.									
FROZEN EXPANSION										C STAR = 8169.7 FT/SEC									
										I SEA I AT I AT I VAC CF SEA CF VAC									
LVL 10000 50000										LVL									
FSLON PC/P P PSIA TEMP ENTHALPY CP CAL/ I OPT DELVAC DELVAC I SEA I AT I AT I VAC CF SEA CF VAC										LVL									
1.000 500.000 3325.7 -21.86 1.711																			
1.000	1.856	163.379	2892.5	-59.26	1.483	180.5	158.3	1.741	344.9	310.1	317.4	318.8	1.207	1.256					
2.000	10.127	29.626	1929.7	-158.37	1.790	318.9	51.6	1.741	344.9	352.6	367.5	370.5	1.358	1.459					
3.000	18.900	15.873	1631.7	-161.52	1.766	344.6	40.4	2.544	351.6	362.9	344.7	349.0	1.385	1.532					
4.000	29.780	10.074	1446.4	-175.81	1.749	365.5	34.2	3.194			344.0	349.7		1.574					
5.000	42.254	7.103	1325.1	-184.90	1.746	376.7	30.2	4.257			349.7	356.9		1.603					
6.000	55.509	5.404	1224.0	-191.93	1.726	384.7	27.5	5.091			353.5	362.2		1.623					
7.000	70.800	4.237	1147.6	-197.46	1.719	390.9	25.5	5.777			356.0	366.2		1.639					
8.000	86.463	3.450	1085.1	-201.91	1.715	395.9	23.6	6.455			357.8	369.5		1.652					
9.000	103.449	2.897	1032.7	-205.48	1.709	399.9	22.3	7.090			359.1	372.2		1.665					
10.000	120.259	2.495	987.9	-208.82	1.706	403.3	21.1	7.674			360.0	374.5		1.672					
11.000	139.216	2.155	944.9	-211.57	1.703	406.5	20.2	8.213			360.5	376.5		1.679					
12.000	159.220	1.888	914.6	-213.97	1.700	408.9	19.2	8.724			360.7	378.2		1.686					
13.000	179.880	1.688	884.1	-216.11	1.698	411.1	18.6	9.212			360.8	379.7		1.692					
14.000	200.987	1.493	854.8	-218.01	1.697	413.1	17.9	9.686			360.9	381.0		1.698					
15.000	222.514	1.349	832.1	-219.75	1.695	414.9	17.3	10.145			361.0	382.3		1.702					
16.000	244.638	1.230	809.6	-221.29	1.694	416.6	16.8	10.592			361.1	383.4		1.707					
17.000	265.459	1.130	789.0	-222.72	1.693	418.1	16.3	11.024			361.2	384.4		1.711					
18.000	289.029	1.038	770.1	-224.01	1.692	419.4	15.9	11.444			361.3	385.3		1.714					
19.000	315.083	.955	752.6	-225.24	1.691	420.7	15.4	11.854			361.4	386.1		1.718					
20.000	339.537	.884	736.4	-226.36	1.690	421.8	15.1	12.252			361.5	386.9		1.721					
21.000	365.604	.821	721.3	-227.40	1.690	422.9	14.7	12.638			361.6	387.6		1.725					
22.000	392.099	.765	707.2	-228.57	1.689	423.9	14.4	13.012			361.7	388.3		1.728					
23.000	418.945	.716	694.0	-229.78	1.689	424.8	14.1	13.374			361.8	389.0		1.729					
24.000	446.065	.673	681.6	-230.14	1.688	425.7	13.8	13.724			361.9	389.5		1.731					
25.000	473.395	.633	669.9	-230.94	1.688	426.5	13.6	14.062			362.0	390.1		1.733					
26.000	500.878	.599	658.8	-231.72	1.688	427.3	13.3	14.387			362.1	390.6		1.735					
27.000	528.468	.568	648.4	-232.42	1.687	428.0	13.1	14.704			362.2	391.1		1.737					
28.000	556.151	.539	638.4	-233.10	1.687	428.7	12.9	15.012			362.3	391.6		1.739					
29.000	583.843	.514	629.0	-233.75	1.687	429.4	12.6	15.312			362.4	392.0		1.741					
30.000	612.353	.490	620.0	-234.37	1.687	430.0	12.4	15.604			362.5	392.5		1.742					
31.000	641.596	.468	611.5	-234.95	1.686	430.5	12.3	15.887			362.6	393.0		1.744					
32.000	671.319	.444	603.1	-235.52	1.686	431.2	12.1	16.166			362.7	393.5		1.746					
33.000	702.519	.424	595.5	-236.05	1.686	431.7	11.9	16.437			362.8	394.0		1.747					
34.000	734.163	.405	588.0	-236.57	1.686	432.2	11.7	16.700			362.9	394.5		1.748					
35.000	767.174	.388	580.9	-237.08	1.686	432.7	11.5	16.957			363.0	395.0		1.750					
36.000	801.537	.372	574.0	-237.55	1.686	433.2	11.4	17.207			363.1	395.5		1.751					
37.000	837.216	.357	567.4	-237.98	1.686	433.7	11.3	17.452			363.2	396.0		1.752					
38.000	874.179	.343	561.0	-238.42	1.686	434.1	11.2	17.692			363.3	396.5		1.753					
39.000	912.491	.330	554.9	-238.84	1.686	434.5	11.0	17.927			363.4	397.0		1.755					
40.000	952.222	.318	549.0	-239.24	1.686	434.9	10.9	18.157			363.5	397.5		1.756					
41.000	993.443	.307	543.3	-239.63	1.686	435.3	10.8	18.382			363.6	398.0		1.757					
42.000	1036.226	.296	537.8	-240.01	1.686	435.7	10.7	18.602			363.7	398.5		1.758					
43.000	1080.615	.286	532.5	-240.38	1.686	436.0	10.5	18.815			363.8	399.0		1.759					
44.000	1126.674	.277	527.3	-240.75	1.686	436.4	10.4	19.021			363.9	399.5		1.760					
45.000	1174.464	.269	522.3	-241.10	1.686	436.7	10.3	19.220			364.0	400.0		1.761					
46.000	1223.935	.260	517.5	-241.40	1.686	437.1	10.2	19.412			364.1	400.5		1.762					
47.000	1275.035	.253	512.9	-241.72	1.685	437.4	10.1	19.600			364.2	401.0		1.763					
48.000	1327.822	.246	508.4	-242.03	1.685	437.7	10.0	19.784			364.3	401.5		1.764					
49.000	1382.347	.240	504.0	-242.33	1.685	438.0	9.9	19.964			364.4	402.0		1.765					
50.000	1438.662	.232	499.7	-242.62	1.685	438.3	9.8	20.140			364.5	402.5		1.766					
51.000	1496.814	.224	495.4	-242.90	1.685	438.6	9.7	20.312			364.6	403.0		1.767					
52.000	1556.854	.216	491.0	-243.16	1.685	438.9	9.6	20.480			364.7	403.5		1.768					
53.000	1618.834	.208	486.6	-243.41	1.685	439.2	9.5	20.644			364.8	404.0		1.769					
54.000	1682.804	.200	482.1	-243.65	1.685	439.5	9.4	20.804			364.9	404.5		1.770					
55.000	1748.814	.192	477.6	-243.88	1.685	439.8	9.3	20.960			365.0	405.0		1.771					
56.000	1816.914	.184	473.0	-244.10	1.685	440.1	9.2	21.112			365.1	405.5		1.772					
57.000	1887.154	.176	468.4	-244.31	1.685	440.4	9.1	21.260			365.2	406.0		1.773					
58.000	1959.584	.168	463.7	-244.51	1.685	440.7	9.0	21.404			365.3	406.5		1.774					
59.000	2034.254	.160	459.0	-244.70	1.685	441.0	8.9	21.544			365.4	407.0		1.775					
60.000	2111.214	.152	454.2	-244.88	1.685	441.3	8.8	21.680			365.5	407.5		1.776					

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 85.2 F2 1.51 -3.47 89.
 20.4 H2 0.071 -1.887 11.
 BULK DENSITY = .468 GM/CC
 MIXTURE RATIO = 8.091 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 425.07 EU/100GMS

	CHAMBER												THROAT	
	FROZEN EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	163.0	
TEMP, DEG K	3785.8	3130.4	2575.6	2106.8	1797.3	1711.1	1378.8	1101.9	874.9	691.8	545.9	430.6	3276.5	
ENTHALPY (-)	18.42	64.35	102.25	133.33	153.25	158.69	179.19	195.65	208.76	219.15	227.36	233.84	54.21	
CP	.7091	.6921	.6733	.6521	.6340	.6283	.6049	.5847	.5712	.5642	.5618	.5610	.6960	
IMPUL OPT		199.88	270.04	316.16	342.46	349.30	373.97	392.64	406.91	417.87	426.32	432.88	176.44	
IMPUL VAC		313.21	339.05	364.38	380.44	384.75	400.65	412.95	422.47	429.85	435.59	440.08	310.82	
EPSILON		1.020	1.384	2.153	3.134	3.524	5.907	10.013	17.084	29.296	50.464	87.287	1.000	
	SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	169.4	
TEMP, DEG K	3785.8	3414.8	3065.2	2720.8	2449.0	2364.5	1995.3	1644.3	1337.8	1079.1	864.9	690.4	3518.2	
ENTHALPY (-)	18.42	65.80	107.56	144.24	169.10	176.09	203.20	225.75	244.20	259.15	271.17	280.78	52.85	
X BAR	8.370	8.185	8.028	7.909	7.847	7.835	7.805	7.799	7.798	7.798	7.798	7.798	8.235	
N	8.370	8.185	8.028	7.909	7.847	7.835	7.805	7.799	7.798	7.798	7.798	7.798	8.235	
CP	1.9398	1.7063	1.4273	1.1225	.9063	.8498	.6830	.6177	.5884	.5680	.5544	.5471	1.7781	
IMPUL OPT		203.00	278.46	330.83	362.04	370.34	400.92	424.68	443.18	457.61	468.89	477.73	173.04	
IMPUL VAC		322.03	354.86	387.06	407.94	413.59	434.50	450.79	463.53	473.51	481.33	487.47	317.79	
EPSILON		1.034	1.478	2.423	3.656	4.150	7.177	12.425	21.572	37.526	65.366	114.047	1.000	
	COMPOSITION SHIFTING (MOL/100 GM)													
18.86 F	.0418	.0171	.0058	.0014	.0003	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0225	
-64.50 F=H	4.6424	4.6671	4.6785	4.6828	4.6839	4.6840	4.6842	4.6842	4.6842	4.6842	4.6842	4.6842	4.6617	
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
52.10 H	1.1015	.7552	.4540	.2193	.0977	.0719	.0126	.0010	.0000	.0000	.0000	.0000	.8504	
.00 H2	2.5844	2.7452	2.8901	3.0053	3.0655	3.0784	3.1079	3.1137	3.1142	3.1142	3.1142	3.1142	2.7003	

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 85.2 F2 1.51 -3.47 95.
 20.4 H2 0.071 -1.887 5.

BULK DENSITY = .750 GM/CC
 MIXTURE RATIO = 19.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 314.39 EU/100GMS

CHAMBER													THROAT
FROZEN EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	161.2
TEMP, DEG K	4597.6	3746.1	3040.9	2456.9	2078.2	1913.7	1574.6	1246.6	980.0	766.6	598.5	466.8	3923.1
ENTHALPY (-)	13.35	52.26	83.90	109.53	125.77	130.18	146.71	159.86	170.23	178.37	184.72	189.68	44.22
CP	.4604	.4531	.4439	.4331	.4236	.4211	.4076	.3939	.3843	.3788	.3771	.3775	.4543
IMPUL OPT	183.97	247.72	289.25	312.71	318.79	340.60	357.00	369.42	378.87	386.10	391.65	397.71	163.87
IMPUL VAC	287.47	310.12	332.42	346.49	350.26	364.10	374.75	382.90	389.16	393.97	397.71	402.56	285.56
EPSILON	1.018	1.366	2.106	3.045	3.418	5.683	9.560	16.175	27.473	46.868	80.261	1.000	
SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	171.9
TEMP, DEG K	4597.6	4259.6	3955.2	3675.5	3472.2	3411.8	3154.1	2888.1	2587.6	2209.0	1817.8	1483.0	4358.7
ENTHALPY (-)	13.35	54.16	90.94	124.20	147.59	154.34	181.67	206.33	228.39	247.56	263.54	276.64	42.18
X BAR	5.880	5.709	5.553	5.412	5.314	5.286	5.177	5.087	5.024	5.001	5.000	5.000	5.759
N	5.880	5.709	5.553	5.412	5.314	5.286	5.177	5.087	5.024	5.001	5.000	5.000	5.759
CP	2.5558	2.4568	2.2891	2.0547	1.8326	1.7602	1.4194	1.0458	.6799	.4282	.3985	.3830	2.4923
IMPUL OPT	188.40	259.79	310.53	341.72	350.21	382.65	409.72	432.51	451.38	466.52	478.57	485.35	158.35
IMPUL VAC	299.98	332.87	365.91	388.40	394.73	419.54	440.72	458.49	472.53	483.36	491.97	495.39	
EPSILON	1.039	1.516	2.558	3.985	4.579	8.450	15.812	29.517	53.526	94.892	168.055	1.000	
COMPOSITION SHIFTING (MOL/100 GM)													
18.86 F	1.0467	.8491	.6704	.5098	.3987	.3671	.2430	.1406	.0675	.0405	.0397	.0397	.9072
-64.50 F+H	3.9532	4.1508	4.3296	4.4902	4.6013	4.6329	4.7570	4.8594	4.9325	4.9595	4.9603	4.9603	4.0927
.00 F2	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.7522	.6078	.4751	.3540	.2693	.2451	.1500	.0724	.0194	.0007	.0000	.0000	.6505
.00 H2	.1275	.1008	.0778	.0581	.0448	.0411	.0266	.0143	.0042	.0001	.0000	.0000	.1085

SYSTEM LIQUID NITROGEN										PC 100 PSIA		HEAT FORM		WT. O/O			
COMPONENT										TREF FORMULA		DENSITY		1KCAL/FORM.WT.1		5	
										DEG K		GM/CC		-3.87		95	
										528.32		1.51		-1.887		5.	
										20.4 M2		0.071					
FROZEN EXPANSION																	
STAR = 7285.4 FT/SEC																	
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DEL VAC	DEL VAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC			
			DEG K	KCAL/100GM	GM DEG				LVL	10000	50000		LVL				
1.000	1.000	500.000	527.6	-13.35	1.000												
1.000	1.061	101.205	392.1	-44.22	1.001	101.2	121.7	75.5	274.5	277.8	284.5	285.4	1.212	1.248			
2.000	10.465	28.668	2510.7	107.21	1.034	286.0	44.2	1.542	507.6	514.4	527.6	530.2	1.558	1.458			
3.000	19.939	15.044	2092.1	-125.18	1.024	511.9	34.1	2.266	512.7	522.7	542.1	546.0	1.581	1.526			
4.000	11.727	9.456	1840.1	-135.77	1.017	326.3	28.7	5.050			549.8	555.0		1.568			
5.000	45.146	6.645	1666.6	-142.95	1.011	455.8	25.2	5.795			554.5	561.0		1.594			
6.000	59.779	5.018	1536.9	-148.25	1.008	522.0	22.8	6.544			557.6	562.8		1.613			
7.000	76.459	3.924	1414.4	-152.10	1.002	547.8	21.0	7.540			559.8	568.7		1.628			
8.000	95.994	3.192	1350.8	-155.73	1.008	551.2	19.5	8.110			561.0	571.4		1.640			
9.000	111.899	2.641	1281.0	-158.50	1.005	555.3	18.4	8.835			562.0	573.7		1.650			
10.000	130.998	2.290	1221.5	-160.46	1.003	558.2	17.3	9.567			562.6	575.5		1.658			
11.000	152.266	1.970	1169.5	-162.49	1.001	560.7	16.5	10.465			562.9	577.2		1.664			
12.000	174.415	1.720	1125.9	-164.67	1.000	562.8	15.7	11.522			562.9	578.6		1.672			
13.000	197.196	1.521	1083.5	-166.24	1.000	564.7	15.1	12.624			562.9	579.8		1.677			
14.000	220.403	1.361	1047.5	-167.64	1.000	566.4	14.5	13.763			562.9	580.9		1.682			
15.000	243.869	1.230	1014.6	-168.94	1.000	567.8	14.0	14.936			562.9	581.9		1.686			
16.000	267.441	1.122	985.0	-170.24	1.000	569.2	13.6	16.091			562.9	582.8		1.690			
17.000	291.089	1.021	957.8	-171.09	1.000	570.4	13.1	17.246			562.9	583.6		1.694			
18.000	314.787	0.934	932.8	-172.04	1.000	571.5	12.8	18.401			562.9	584.3		1.697			
19.000	338.426	0.859	909.7	-172.91	1.000	572.4	12.4	19.556			562.9	585.0		1.700			
20.000	362.097	0.795	888.4	-173.78	1.000	573.5	12.1	20.711			562.9	585.6		1.703			
21.000	385.709	0.740	868.5	-174.50	1.000	574.4	11.8	21.866			562.9	586.2		1.705			
22.000	409.254	0.690	850.0	-175.20	1.000	575.2	11.5	23.021			562.9	586.7		1.708			
23.000	432.836	0.641	832.6	-175.86	1.000	576.0	11.3	24.176			562.9	587.2		1.710			
24.000	456.450	0.602	816.5	-176.49	1.000	576.7	11.0	25.331			562.9	587.7		1.712			
25.000	480.089	0.567	801.0	-177.07	1.000	577.4	10.8	26.486			562.9	588.2		1.714			
26.000	503.754	0.536	786.5	-177.61	1.000	578.0	10.6	27.641			562.9	588.6		1.716			
27.000	527.446	0.508	772.4	-178.11	1.000	578.6	10.4	28.796			562.9	589.0		1.718			
28.000	551.167	0.481	759.9	-178.57	1.000	579.2	10.2	29.951			562.9	589.4		1.719			
29.000	574.919	0.456	747.6	-179.00	1.000	579.7	10.0	31.106			562.9	589.7		1.721			
30.000	598.692	0.432	735.9	-179.51	1.000	580.2	9.8	32.261			562.9	590.0		1.722			
31.000	622.486	0.411	724.4	-179.95	1.000	580.7	9.7	33.416			562.9	590.4		1.724			
32.000	646.301	0.391	714.2	-180.35	1.000	581.1	9.5	34.571			562.9	590.7		1.725			
33.000	670.136	0.373	704.1	-180.75	1.000	581.6	9.4	35.726			562.9	591.0		1.726			
34.000	693.991	0.357	694.4	-181.10	1.000	582.1	9.2	36.881			562.9	591.2		1.728			
35.000	717.866	0.341	685.1	-181.45	1.000	582.4	9.1	38.036			562.9	591.5		1.729			
36.000	741.761	0.327	676.2	-181.78	1.000	582.8	9.0	39.191			562.9	591.8		1.730			
37.000	765.676	0.314	667.7	-182.11	1.000	583.1	8.9	40.346			562.9	592.0		1.731			
38.000	789.611	0.301	659.5	-182.42	1.000	583.5	8.7	41.501			562.9	592.2		1.732			
39.000	813.566	0.290	651.6	-182.71	1.000	583.8	8.6	42.656			562.9	592.5		1.733			
40.000	837.541	0.279	644.0	-183.00	1.000	584.2	8.5	43.811			562.9	592.7		1.734			
41.000	861.536	0.269	636.7	-183.29	1.000	584.5	8.4	44.966			562.9	592.9		1.735			
42.000	885.551	0.260	629.4	-183.58	1.000	584.8	8.3	46.121			562.9	593.1		1.736			
43.000	909.586	0.252	622.4	-183.87	1.000	585.1	8.2	47.276			562.9	593.3		1.737			
44.000	933.641	0.245	615.7	-184.15	1.000	585.4	8.1	48.431			562.9	593.5		1.738			
45.000	957.716	0.238	609.4	-184.42	1.000	585.7	8.0	49.586			562.9	593.7		1.739			
46.000	981.811	0.229	603.6	-184.69	1.000	585.9	8.0	50.741			562.9	593.9		1.739			
47.000	1005.926	0.222	598.2	-184.95	1.000	586.2	7.9	51.896	512.7	522.7	542.7	546.5	1.581	1.515			

SHIFTING EXPANSION															
C STAR = 7285.4 FT/SEC															
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DEL VAC	DEL VAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC	
			DEG K	KCAL/100GM	GM DEG				LVL	10000	50000		LVL		
1.000	1.000	500.000	527.6	-13.35	1.000										
1.000	1.145	171.937	355.7	-42.18	1.042	154.4	147.0	70.7	274.7	277.8	284.5	285.4	1.215	1.186	
2.000	8.229	26.455	275.9	-110.24	1.077	271.2	60.6	1.602	527.5	534.7	548.9	551.7	1.567	1.471	
5.000	15.917	21.556	259.9	-155.01	1.077	522.7	51.4	2.403	559.7	569.4	570.4	574.5	1.581	1.566	
6.000	20.517	14.622	247.6	-147.78	1.053	542.0	46.6	5.186	555.4	565.1	588.6		1.625		
5.000	27.685	10.857	237.4	-154.50	1.113	555.1	43.5	5.991	557.6	561.8	598.6		1.667		
6.000	35.252	8.421	227.2	-160.22	1.163	568.4	40.8	6.800	559.8	563.1	609.5		1.699		
7.000	43.027	6.340	217.5	-165.96	1.227	577.4	38.2	7.614	562.0	565.3	617.4		1.725		
8.000	51.192	5.060	210.9	-170.37	1.251	580.0	37.5	8.424	564.6	567.9	627.5		1.746		
9.000	59.596	4.034	212.0	-174.20	1.282	585.6	36.2	9.237	567.0	570.3	637.6		1.768		
10.000	68.569	3.375	208.4	-178.54	1.320	590.4	35.2	10.046	569.4	572.7	647.6		1.780		
11.000	77.715	2.940	204.4	-182.81	1.363	594.7	34.2	10.859	571.8	575.1	657.6		1.794		
12.000	86.950	2.650	200.7	-187.01	1.411	598.4	33.4	11.677	574.2	577.5	667.6		1.808		
13.000	96.203	2.318	197.5	-191.03	1.464	601.8	32.7	12.495	576.6	579.9	677.6		1.817		
14.000	105.424	2.046	194.1	-194.76	1.519	604.7	32.0	13.313	579.0	582.3	687.6		1.827		
15.000	114.585	1.818	191.4	-198.27	1.577	607.6	31.4	14.131	581.4	584.7	697.6		1.836		
16.000	123.688	1.622	188.2	-201.67	1.639	610.2	30.9	14.949	583.8	587.1	707.6		1.845		
17.000	132.731	1.456	185.6	-204.91	1.701	612.6	30.4	15.767	586.2	589.5	717.6		1.853		
18.000	141.714	1.318	183.0	-208.01	1.766	614.4	29.9	16.585	588.6	591.9	727.6		1.861		
19.000	150.637	1.204	180.5	-210.98	1.833	616.4	29.4	17.403	591.0	594.3	737.6		1.869		
20.000	159.500	1.104	178.1	-213.83	1.902	618.7	29.0	18.221	593.2	596.5	747.6		1.877		
21.000	168.313	1.016	175.8	-216.56	1.973	620.4	28.7	19.039	595.4	598.7	757.6		1.885		
22.000	177.076	0.938	173.6	-219.18	2.045	622.2	28.5	19.857	597.6	600.9	767.6		1.893		
23.000	185.789	0.869	171.6	-221.69	2.119	624.4	28.3	20.675	599.8	603.1	777.6		1.901		
24.000	210.051	0.828	169.5	-224.12	2.194	626.3	27.8	21.493	602.0	605.3	787.6		1.909		
25.000	221.149	0.787	167.4	-226.44	2.271	628.4	27.4	22.311	604.2	607.5	797.6		1.916		
26.000	232.288	0.749	165.4	-228.68	2.349	630.7	27.0	23.129	606.4	610.7	807.6		1.923		
27.000	243.451	0.715	163.3	-230.87	2.428	633.1	26.7	23.947	608.6	612.9	817.6		1.930		
28.000	254.632	0.684	161.0	-232.96	2.507	635.6	26.4	24.765	610.8	615.1	827.6		1.937		
29.000	265.835	0.655	158.7	-234.97	2.587	638.1	26.1	25.583	613.0	617.3	837.6		1.944		
30.000	277.027	0.628	156.2	-236.94	2.671	640.7	25.9	26.393	615.2	619.5	847.6		1.951		
31.000	288.170	0.603	153.6	-238.85	2.756	643.4	25.7	27.203	617.4	621.7	857.6		1.958		
32.000	299.281	0.579	151.1	-240.72	2.842	646.2	25.5	28.013	619.6	623.9	867.6		1.965		
33.000	310.354	0.556	148.4	-242.55	2.929	649.0	25.3	28.823	621.8	626.1	877.6		1.972		
34.000	321.397	0.534	145.7	-244.34	3.017	651.8	25.1	29.633	624.0	628.3	887.6		1.979		
35.000	332.410	0.512	143.0	-246.09	3.106	654.6	24.9	30.443	626.2	630.5	897.6		1.986		
36.000	343.393	0.491	140.3	-247.81	3.196	657.4	24.7	31.253	628.4	632.7	907.6		1.993		
37.000	354.346	0.470	137.6	-249.49	3.287	660.2	24.5	32.063	630.6	634.9	917.6		2.000		
38.000	365.269	0.450	134.9	-251.14	3.379	663.0	24.3	32.873	632.8	637.1	927.6		2.007		
39.000	376.162	0.430	132.2	-252.76	3.472	665.8	24.1	33.683	635.0	639.3	937.6		2.014		
40.000	387.025	0.410	129.5	-254.35	3.566	668.6	24.0	34.493	637.2	641.5	947.6		2.021		
41.000	397.858	0.390	126.8	-255.91	3.661	671.4	23.8	35.303	639.4	643.7	957.6		2.028		
42.000	408.661	0.370	124.1	-257.44	3.757	674.2	23.6	36.113	641.6	645.9	967.6		2.035		
43.000	419.434	0.350	121.4	-258.95	3.854	677.0	23.4	36.923	643.8	648.1	977.6		2.042		
44.000	430.177	0.330	118.7	-260.44	3.952	680.0	23.3	37.733	646.0	650.3	987.6		2.049		
45.000	440.890	0.310	116.0	-261.91	4.051	683.0	23.1	38.543	648.2	652.5	997.6		2.056		
46.000	451.573	0.290	113.3	-263.36	4.151	686.0	22.9	39.353	650.4	654.7	1007.6		2.063		
47.000	462.226	0.270	110.6	-264.79	4.252	689.0	22.7	40.163	652.6	656.9	1017.6		2.070		
48.000	472.849	0.250	107.9	-266.20	4.354	692.0	22.5	40.973	654.8	659.1	1027.6		2.077		
49.000	483.442	0.230	105.2	-267.59	4.457	695.0	22.3	41.783	657.0	661.3	1037.6		2.084		
50.000	494.005	0.210	102.5	-268.96	4.561	698.0	22.1	42.593	659.2	663.5	1047.6		2.091		
51.000	504.538	0.190	99.8	-270.31	4.666	701.0	21.9	43.403	661.4	665.7	1057.6		2.098		
52.000	515.041	0.170	97.1	-271.64	4.772	704.0	21.7	44.213	663.6	667.9	1067.6		2.105		
53.000	525.514	0.150	94.4	-272.96	4.879	707.0	21.5	45.023	665.8	670.1	1077.6		2.112		
54.000	535.957	0.130	91.7	-274.27	4.987	710.0	21.3	45.833	668.0	672.3	1087.6		2.119		
55.000	546.370	0.110	89.0	-275.57	5.096	713.0	21.1	46.643	670.2	674.5	1097.6		2.126		
56.000	556.753	0.090	86.3	-276.86	5.206	716.0	20.9	47.453	672.4	676.7	1107.6		2.133		
57.000	567.106	0.070	83.6	-278.14	5.317	719.0	20.7	48.263	674.6	678.9	1117.6		2.140		
58.000	577.429	0.050	80.9	-279.41	5.429	722.0	20.5	49.073	676.8	681.1	1127.6		2.147		
59.000	587.722	0.030	78.2	-280.67	5.542	725.0	20.3	49.883	679.0	683.3	1137.6		2.154		
60.000	598.005	0.010	75.5	-281.92	5.657	728.0	20.1	50.693	681.2	685.5	1147.6		2.161		
61.000	608.278	0.000	72.8	-283.16	5.772	731.0	19.9	51.503	683.4	687.7	1157.6		2.168		
62.000	618.531	0.000	70.1	-284.39	5.888	734.0	19.7	52.313	685.6	689.9	1167.6		2.175		
63.000	628.764	0.000	67.4	-285.61	6.005	737.0	19.5	53.123	687.8	692.1	1177.6		2.182		
64.000	638.977	0.000	64.7	-286.83	6.123	740.0	19.3	53.933	690.0	694.3	1187.6		2.189		
65.000	649.170	0.000	62.0	-288.04	6.242	743.0	19.1	54.743	692.2	696.5	1197.6		2.196		
66.000	659.343	0.000	59.3	-289.25	6.362	746.0	18.9	55.553	694.4	698.7	1207.6		2.203		
67.000	669.496	0.000	56.6	-290.45	6.483	749.0	18.7	56.363	696.6	700.9	1217.6		2.210		
68.000	679.629	0.000	53.9	-291.65	6.605	752.0	18.5	57.173	698.8	703.1	1227.6		2.217		
69.000	689.742	0.000	51.2	-292.84	6.728	755.0	18.3	57.983	701.0	705.3	1237.6		2.224		
70.000	699.835	0.000	48.5	-294.03	6.852	758.0	18.1	58.793	703.2	707.5	1247.6		2.231		
71.000	709.908	0.000	45.8	-295.21	6.977	761.0	17.9	59.603	705.4	709.7	1257.6		2.238		
72.000	719.961	0.000	43.1	-296.39	7.103	764.0	17.7	60.413	707.6	711.9	1267.6		2.245		
73.000	729.994	0.000	40.4	-297.56	7.230	767.0	17.5	61.223	709.8	714.1	1277.6		2.252		
74.000	739.997	0.000	37.7	-298.73	7.358	770.0	17.3	62.033	712.0	716.3	1287.6		2.259		
75.000	749.970	0.000	35.0	-299.89	7.487	773.0	17.1	62.843	714.2	718.5	1297.6		2.266		
76.000	759.913	0.000	32.3	-301.05	7.617	776.0	16.9	63.653	716.4	720.7	1307.6		2.273		
77.000	769.826	0.000	29.6	-302.20	7.748	779.0	16.7	64.463	718.6	722.9	1317.6		2.280		
78.000	779.709	0.000	26.9	-303.35	7.880	782.0	16.5	65.273	720.8	725.1	1327.6		2.287		
79.000	789.562	0.000	24.2	-304.49	8.013	785.0	16.3	66.083	723.0	727.3	1337.6		2.294		
80.000	799.385	0.000	21.5	-305.63	8.147	788.0	16.1	66.893	725.2	729.5	1347.6		2.301		
81.0															

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Ford Motor Company
AERONUTRONIC DIVISION

H_2O_2 - B_5H_9 SYSTEM

PRESSURE PROFILE DATA
 SYSTEM LIQUID PROPELLANT PC 1000 PSIA PE 101 PSIA
 COMPONENT I-EE FORMULA DENSITY PLAT FORM WT. G/G
 DEG K GM/CC (KCAL/FORM.WT.)
 29H H2O2 1.448 -44.84 69.
 29H H5F9 0.620 +7.74 35.

BULK DENSITY = .778 GM/CC
 MIXTURE RATIO = 1.77H LH OXIDIZER / LH OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 529.15 FU/100JMS

CHAMBER	THROAT													
	FROZEN EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	5.921	1.583	.631	.251	.100	563.2	
TEMP, DEG K	2674.7	2504.6	2357.0	2212.6	2085.0	2010.4	1958.8	1894.6	1740.1	1660.7	1545.4	1372.6	2432.2	
ENTHALPY (-)	79.98	107.10	132.00	154.67	175.61	187.03	194.70	212.67	229.07	244.35	258.64	272.02	96.29	
CP	.7237	.7066	.6956	.6791	.6608	.6496	.6421	.6235	.6055	.5967	.5865	.5750	.7197	
IMPUL OPT	151.53	206.72	244.36	272.45	295.78	314.27	328.34	338.45	347.00	354.85	362.85	370.91	121.36	
IMPUL VAC	227.84	254.82	279.23	299.15	308.94	315.27	328.34	338.45	347.00	354.85	362.85	370.91	222.14	
EPSILON	1.071	1.695	5.088	5.259	8.807	11.735	23.541	47.631	96.788	192.148	403.656	1.000		
	SHIFTING EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	5.921	1.583	.631	.251	.100	580.0	
TEMP, DEG K	2674.7	2504.6	2357.0	2212.6	2085.0	2010.4	1958.8	1894.6	1740.1	1660.7	1545.4	1372.6	2571.6	
ENTHALPY (-)	79.98	107.10	132.00	154.67	175.61	187.03	194.70	212.67	229.07	244.35	258.64	272.02	96.29	
X BAK	5.799	5.652	5.510	5.388	5.270	5.163	5.072	4.987	4.902	4.826	4.750	4.675	5.711	
N	5.895	5.889	5.885	5.881	5.878	5.876	5.875	5.873	5.870	5.865	5.852	5.837	5.891	
CP	5.0418	5.0711	4.2275	4.2602	5.5961	5.1777	2.8582	2.0677	6.1440	5.4490	4.6675	4.8104	4.9495	
IMPUL OPT	153.58	212.72	254.89	288.43	305.16	316.19	339.75	366.14	378.14	374.24	408.74	119.09		
IMPUL VAC	233.27	265.51	295.42	321.33	334.81	343.84	363.42	380.89	396.60	410.90	423.69	225.71		
EPSILON	1.090	1.813	3.489	7.132	10.786	15.058	32.363	71.284	159.301	354.049	814.355	1.000		
	COMPOSITION SHIFTING (MOL/100 LM)													
132.60 H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
114.76 H+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-47.13 H+H+O	1.0528	.9423	.8443	.7556	.6778	.6363	.6080	.5833	.5633	.5487	.5387	.5327	.9861	
-135.32 H+H+O2	.5142	.4052	.3631	.2156	.1595	.1023	.0790	.0355	.0219	.0156	.0107	.0070	.4491	
66.00 H+H2	.0006	.0003	.0002	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-45.00 H+H2+O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
18.00 H+H3	.0012	.0007	.0005	.0003	.0002	.0002	.0002	.0003	.0002	.0001	.0001	.0000	.0007	
-236.60 H+H3+O2	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	
5.74 H+O	.0204	.0146	.0106	.0072	.0048	.0037	.0030	.0017	.0010	.0006	.0004	.0002	.0167	
-84.00 H+O2	.0030	.0018	.0011	.0006	.0003	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0023	
199.30 H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-111.60 H2+O2	.2818	.2668	.2539	.2475	.2443	.2450	.2468	.2566	.2237	.1775	.1337	.0922	.2726	
-210.10 H2+O3	.2504	.2366	.2165	.1943	.1609	.1362	.1216	.0761	.0376	.0471	.0366	.0263	.2444	
-541.69 H3+H3+O6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
52.10 H	.0284	.0225	.0180	.0134	.0094	.0060	.0068	.0042	.0030	.0022	.0016	.0011	.0246	
9.33 H+O	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	
.00 H2	3.5944	3.7273	3.8432	3.9427	4.0269	4.0692	4.0966	4.1134	4.2063	4.2549	4.2982	4.3369	4.6749	
-57.80 H2+O	.0512	.0321	.0191	.0103	.0050	.0031	.0020	.0006	.0003	.0002	.0001	.0001	.0391	
59.56 O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-305.34 H2+O3/C	.0983	.2367	.3744	.4932	.6081	.6701	.7121	.8016	.8815	.9570	1.0270	1.0912	.1798	
.00 H/L	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0476	.1063	.1608	.2109	.0000	

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000, PSIA PE 0.1 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. %
 DEG K GM/CC (KCAL/100MM.KT.)
 298 H2+P2 1.044 -44.84 6%
 298 O5+P2 0.620 +7.74 52%

BULK DENSITY = 1.014 GM/CC
 MIXTURE RATIO = 2.125 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 327.55 EU/100GMS

CHAMBER

TEMP

	1000	398.1	158.5	65.10	25.12	14.70	10.00	5.971	1.565	.631	.251	.100	566.2
PRESSURE, PSIA	1000	398.1	158.5	65.10	25.12	14.70	10.00	5.971	1.565	.631	.251	.100	566.2
TEMP, DEG K	2885.1	2489.2	2142.5	1837.5	1569.6	1429.1	1334.6	1126.2	945.9	772.2	657.7	541.4	2635.2
ENTHALPY (-)	25.72	113.18	136.46	137.20	174.61	183.54	187.45	202.04	212.65	221.55	223.50	225.08	103.14
CP	.7005	.6662	.6744	.6544	.6412	.6275	.6208	.6007	.5901	.5791	.5672	.5555	.6955
IMPUL OPT	154.57	210.93	249.37	278.04	291.72	300.41	311.11	322.31	334.15	343.01	350.47	356.11	123.11
IMPUL VAC	232.47	260.05	285.00	305.54	315.41	321.49	325.27	326.11	324.91	322.62	319.47	315.00	226.62
EPSILON	1.071	1.076	1.091	1.097	1.102	1.107	1.112	1.117	1.122	1.127	1.132	1.137	1.142

	1000	398.1	158.5	65.10	25.12	14.70	10.00	5.971	1.565	.631	.251	.100	566.2
PRESSURE, PSIA	1000	398.1	158.5	65.10	25.12	14.70	10.00	5.971	1.565	.631	.251	.100	566.2
TEMP, DEG K	2885.1	2489.2	2142.5	1837.5	1569.6	1429.1	1334.6	1126.2	945.9	772.2	657.7	541.4	2635.2
ENTHALPY (-)	25.72	113.18	136.46	137.20	174.61	183.54	187.45	202.04	212.65	221.55	223.50	225.08	103.14
X HAR	5.594	5.569	5.426	5.299	5.172	5.102	5.053	4.940	4.833	4.733	4.640	4.555	5.578
N	5.594	5.569	5.426	5.299	5.172	5.102	5.053	4.940	4.833	4.733	4.640	4.555	5.578
CP	1.0110	.9507	.72565	.6104	.65911	.64404	.62977	.61479	.60341	.59460	.58605	.57747	.9734
IMPUL OPT	155.76	214.94	257.45	291.24	308.20	319.37	325.43	326.34	322.40	319.22	315.72	312.02	122.02
IMPUL VAC	235.57	267.99	298.17	324.53	338.25	347.49	352.69	353.62	349.66	345.07	340.04	334.71	228.71
EPSILON	1.081	1.086	1.091	1.097	1.102	1.107	1.112	1.117	1.122	1.127	1.132	1.137	1.142

	1000	398.1	158.5	65.10	25.12	14.70	10.00	5.971	1.565	.631	.251	.100	566.2
COMPOSITION SHIFTING (MOL/100 GM)	1000	398.1	158.5	65.10	25.12	14.70	10.00	5.971	1.565	.631	.251	.100	566.2
142.60 B	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
114.76 B+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 B+H+O	.7256	.6064	.5000	.4043	.3200	.2757	.2460	.1818	.1271	.0818	.0466	.0271	.6552
-135.32 B+H+O2	.9971	.9771	.8756	.7829	.6941	.6460	.6132	.5412	.4743	.4247	.3795	.3393	.9899
66.00 B+H2	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-45.00 B+H2+O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 B+H3	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-238.60 B+H3+O3	.0005	.0003	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
5.74 B+O	.0294	.0134	.0092	.0059	.0034	.0029	.0023	.0014	.0008	.0004	.0001	.0000	.0147
-84.00 B+O2	.0126	.0064	.0046	.0032	.0023	.0019	.0016	.0011	.0007	.0005	.0003	.0002	.0086
199.30 B2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.60 B2+O2	.1211	.1120	.0888	.0689	.0511	.0420	.0361	.0237	.0141	.0072	.0029	.0009	.1162
-210.10 B2+O3	.2624	.2525	.2448	.2391	.2315	.2248	.2193	.2086	.2027	.1905	.1831	.1738	.5137
-541.69 B3+H3+O6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.0558	.0294	.0242	.0191	.0154	.0136	.0123	.0097	.0074	.0055	.0037	.0025	.0387
9.33 F+O	.0011	.0003	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
.00 F2	5.1760	5.3428	5.4764	5.5955	5.7000	5.7545	5.7910	5.8091	5.8247	5.8378	5.8482	5.8554	5.8584
-57.80 F2+O	.1915	.1286	.1019	.0797	.0638	.0564	.0518	.0431	.0375	.0347	.0334	.0312	.1522
59.56 O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-305.34 B2+O3/C	.0000	.0000	.1380	.2602	.3856	.4523	.5005	.6113	.7162	.8150	.9071	.9910	.0000

SYSTEM LIQUID HYDROPELLANT					PC 1000, PSIA					PE 0.1 PSIA				
COMPONENT					DENSITY					HEAT FORM				
TRIF FORMULA					UM/CC					(KCAL/FORM.WT.)				
EIG K					1.448					-44.74				
29H H2402					C602C					+1.74				
FREEZE EXPANSION														
C STAR = 5070.0 FT/SEC														
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/ I	OPT DELTAV	EL VAL	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC	
				ELG K	UM/CC		FT/SEC	LVL	10000	50000				
1.000	1.000	1000.000	2885.1	-85.72	1.701									
2.000	1.765	506.469	2635.2	-105.14	1.645	125.1	105.5	1.185	225.7	226.7	1.226	1.246	1.246	
3.000	2.825	316.611	2066.1	-145.50	1.602	240.0	50.0	1.550	275.0	276.5	1.456	1.466	1.466	
4.000	4.158	184.692	1850.2	-150.50	1.589	240.0	50.0	1.550	275.0	276.5	1.509	1.509	1.509	
5.000	5.747	102.577	1725.4	-166.55	1.582	262.0	31.8	1.746	282.8	286.1	1.547	1.547	1.547	
6.000	7.629	61.721	1655.6	-170.57	1.576	271.8	20.1	1.942	286.8	291.0	1.570	1.570	1.570	
7.000	9.813	34.400	1566.1	-174.42	1.571	274.4	12.2	2.107	289.5	294.6	1.588	1.588	1.588	
8.000	12.305	22.227	1500.9	-178.43	1.566	284.0	7.5	2.245	290.8	296.5	1.597	1.597	1.597	
9.000	15.147	16.124	1462.7	-181.42	1.562	288.5	4.5	2.366	291.5	297.0	1.605	1.605	1.605	
10.000	18.387	12.101	1422.5	-183.77	1.559	292.8	2.5	2.465	292.0	297.3	1.612	1.612	1.612	
11.000	22.048	9.240	1380.1	-186.18	1.556	295.6	1.2	2.545	292.5	297.7	1.618	1.618	1.618	
12.000	26.161	7.017	1335.9	-188.12	1.554	298.5	0.6	2.607	292.8	297.9	1.624	1.624	1.624	
13.000	30.772	5.275	1288.1	-189.45	1.552	301.0	0.3	2.654	293.0	298.0	1.629	1.629	1.629	
14.000	35.937	3.919	1237.9	-191.21	1.550	303.2	0.2	2.688	293.1	298.1	1.633	1.633	1.633	
15.000	41.701	2.976	1185.9	-192.85	1.548	305.1	0.1	2.715	293.1	298.1	1.636	1.636	1.636	
16.000	48.119	2.172	1132.9	-194.12	1.546	306.7	0.1	2.734	293.1	298.1	1.639	1.639	1.639	
17.000	55.269	1.572	1079.9	-195.11	1.544	308.0	0.0	2.745	293.1	298.1	1.641	1.641	1.641	
18.000	63.207	1.058	1027.6	-195.84	1.542	309.5	0.0	2.748	293.1	298.1	1.642	1.642	1.642	
19.000	72.004	0.735	974.6	-196.32	1.540	311.7	0.0	2.742	293.1	298.1	1.643	1.643	1.643	
20.000	81.725	0.490	920.1	-196.57	1.539	313.1	0.0	2.738	293.1	298.1	1.644	1.644	1.644	
21.000	92.421	0.309	864.6	-196.61	1.538	314.5	0.0	2.734	293.1	298.1	1.644	1.644	1.644	
22.000	104.159	0.189	808.1	-196.45	1.537	315.8	0.0	2.730	293.1	298.1	1.644	1.644	1.644	
23.000	117.000	0.107	750.6	-196.10	1.536	317.0	0.0	2.726	293.1	298.1	1.644	1.644	1.644	
24.000	131.024	0.062	692.1	-195.57	1.535	318.1	0.0	2.722	293.1	298.1	1.644	1.644	1.644	
25.000	146.309	0.035	632.6	-194.89	1.534	319.1	0.0	2.718	293.1	298.1	1.644	1.644	1.644	
26.000	162.924	0.019	572.1	-193.97	1.533	319.9	0.0	2.714	293.1	298.1	1.644	1.644	1.644	
27.000	180.950	0.009	510.6	-192.83	1.532	320.5	0.0	2.710	293.1	298.1	1.644	1.644	1.644	
28.000	200.476	0.005	448.1	-191.39	1.531	321.0	0.0	2.706	293.1	298.1	1.644	1.644	1.644	
29.000	221.602	0.002	384.6	-189.67	1.530	321.4	0.0	2.702	293.1	298.1	1.644	1.644	1.644	
30.000	244.428	0.001	320.1	-187.69	1.529	321.7	0.0	2.698	293.1	298.1	1.644	1.644	1.644	
31.000	269.054	0.000	255.6	-185.37	1.528	321.9	0.0	2.694	293.1	298.1	1.644	1.644	1.644	
32.000	295.580	0.000	191.1	-182.73	1.527	322.0	0.0	2.690	293.1	298.1	1.644	1.644	1.644	
33.000	324.006	0.000	126.6	-179.79	1.526	322.0	0.0	2.686	293.1	298.1	1.644	1.644	1.644	
34.000	354.432	0.000	62.1	-176.56	1.525	322.0	0.0	2.682	293.1	298.1	1.644	1.644	1.644	
35.000	386.858	0.000	-2.4	-173.05	1.524	322.0	0.0	2.678	293.1	298.1	1.644	1.644	1.644	
36.000	421.284	0.000	-67.1	-169.28	1.523	322.0	0.0	2.674	293.1	298.1	1.644	1.644	1.644	
37.000	457.710	0.000	-132.6	-165.27	1.522	322.0	0.0	2.670	293.1	298.1	1.644	1.644	1.644	
38.000	496.136	0.000	-198.1	-161.03	1.521	322.0	0.0	2.666	293.1	298.1	1.644	1.644	1.644	
39.000	536.562	0.000	-263.6	-156.57	1.520	322.0	0.0	2.662	293.1	298.1	1.644	1.644	1.644	
40.000	579.088	0.000	-329.1	-151.90	1.519	322.0	0.0	2.658	293.1	298.1	1.644	1.644	1.644	
41.000	623.714	0.000	-394.6	-147.03	1.518	322.0	0.0	2.654	293.1	298.1	1.644	1.644	1.644	
42.000	670.440	0.000	-460.1	-141.87	1.517	322.0	0.0	2.650	293.1	298.1	1.644	1.644	1.644	
43.000	719.266	0.000	-525.6	-136.43	1.516	322.0	0.0	2.646	293.1	298.1	1.644	1.644	1.644	
44.000	770.192	0.000	-591.1	-130.72	1.515	322.0	0.0	2.642	293.1	298.1	1.644	1.644	1.644	
45.000	823.318	0.000	-656.6	-124.75	1.514	322.0	0.0	2.638	293.1	298.1	1.644	1.644	1.644	
46.000	878.644	0.000	-722.1	-118.53	1.513	322.0	0.0	2.634	293.1	298.1	1.644	1.644	1.644	
47.000	936.170	0.000	-787.6	-112.07	1.512	322.0	0.0	2.630	293.1	298.1	1.644	1.644	1.644	
48.000	995.896	0.000	-853.1	-105.38	1.511	322.0	0.0	2.626	293.1	298.1	1.644	1.644	1.644	
49.000	1057.822	0.000	-918.6	-98.47	1.510	322.0	0.0	2.622	293.1	298.1	1.644	1.644	1.644	
50.000	1121.948	0.000	-984.1	-91.25	1.509	322.0	0.0	2.618	293.1	298.1	1.644	1.644	1.644	
51.000	1188.274	0.000	-1049.6	-83.74	1.508	322.0	0.0	2.614	293.1	298.1	1.644	1.644	1.644	
52.000	1256.800	0.000	-1115.1	-75.95	1.507	322.0	0.0	2.610	293.1	298.1	1.644	1.644	1.644	
53.000	1327.526	0.000	-1180.6	-67.89	1.506	322.0	0.0	2.606	293.1	298.1	1.644	1.644	1.644	
54.000	1400.452	0.000	-1246.1	-59.56	1.505	322.0	0.0	2.602	293.1	298.1	1.644	1.644	1.644	
55.000	1475.678	0.000	-1311.6	-50.97	1.504	322.0	0.0	2.598	293.1	298.1	1.644	1.644	1.644	
56.000	1553.204	0.000	-1377.1	-42.14	1.503	322.0	0.0	2.594	293.1	298.1	1.644	1.644	1.644	
57.000	1633.030	0.000	-1442.6	-33.07	1.502	322.0	0.0	2.590	293.1	298.1	1.644	1.644	1.644	
58.000	1715.156	0.000	-1508.1	-23.77	1.501	322.0	0.0	2.586	293.1	298.1	1.644	1.644	1.644	
59.000	1800.582	0.000	-1573.6	-14.25	1.500	322.0	0.0	2.582	293.1	298.1	1.644	1.644	1.644	
60.000	1889.308	0.000	-1639.1	-4.52	1.499	322.0	0.0	2.578	293.1	298.1	1.644	1.644	1.644	
61.000	1981.334	0.000	-1704.6	5.21	1.498	322.0	0.0	2.574	293.1	298.1	1.644	1.644	1.644	
62.000	2076.660	0.000	-1770.1	14.74	1.497	322.0	0.0	2.570	293.1	298.1	1.644	1.644	1.644	
63.000	2175.286	0.000	-1835.6	24.03	1.496	322.0	0.0	2.566	293.1	298.1	1.644	1.644	1.644	
64.000	2277.112	0.000	-1901.1	33.08	1.495	322.0	0.0	2.562	293.1	298.1	1.644	1.644	1.644	
65.000	2382.138	0.000	-1966.6	41.90	1.494	322.0	0.0	2.558	293.1	298.1	1.644	1.644	1.644	
66.000	2490.364	0.000	-2032.1	50.40	1.493	322.0	0.0	2.554	293.1	298.1	1.644	1.644	1.644	
67.000	2601.790	0.000	-2097.6	58.58	1.492	322.0	0.0	2.550	293.1	298.1	1.644	1.644	1.644	
68.000	2716.416	0.000	-2163.1	66.45	1.491	322.0	0.0	2.546	293.1	298.1	1.644	1.644	1.644	
69.000	2834.242	0.000	-2228.6	74.01	1.490	322.0	0.0	2.542	293.1	298.1	1.644	1.644	1.644	
70.000	2955.268	0.000	-2294.1	81.26	1.489	322.0	0.0	2.538	293.1	298.1	1.644	1.644	1.644	
71.000	3079.494	0.000	-2359.6	88.19	1.488	322.0	0.0	2.534	293.1	298.1	1.644	1.644	1.644	
72.000	3206.920	0.000	-2425.1	94.81	1.487	322.0	0.0	2.530	293.1	298.1	1.644	1.644	1.644	
73.000	3337.546	0.000	-2490.6	101.12	1.486	322.0	0.0	2.526	293.1	298.1	1.644	1.644	1.644	
74.000	3471.372	0.000	-2556.1	107.13	1.485	322.0	0.0	2.522	293.1	298.1	1.644	1.644	1.644	
75.000	3608.408	0.000	-2621.6	112.84	1.484	322.0	0.0	2.518	293.1	298.1	1.644	1.644	1.644	
76.000	3748.654	0.000	-2687.1	118.25	1.483	322.0	0.0	2.514	293.1	298.1	1.644	1.644	1.644	
77.000	3892.110	0.000	-2752.6	123.36	1.482	322.0	0.0	2.510	293.1	298.1	1.644	1.644	1.644	
78.000	4038.776	0.000	-2818.1	128.17	1.481	322.0	0.0	2.506	293.1	298.1	1.644	1.644	1.644	
79.000	4188.652	0.000	-2883.6	132.68	1.480	322.0	0.0	2.502	293.1	298.1	1.644	1.644	1.644	
80.000	4341.738	0.000	-2949.1	136.89	1.479	322.0	0.0	2.498	293.1	298.1	1.644	1.644	1.644	
81.000	4498.034	0.000	-3014.6	140.80	1.478	322.0	0.0	2.494	293.1	298.				

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA PE 0.1 PSIA

COMPONENT	TREF FORMULA DEG K	DENSITY GM/CC	HEAT FORM (KCAL/FORM.WT.)	WT. O/O
298 H2*O2		1.448	-44.84	70.
298 B5*H9		0.620	+7.74	30.

PULK DENSITY = 1.034 GM/CC
MIXTURE RATIO = 2.333 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 325.59 EU/100GMS

CHAMBER

THROAT

	FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	564.6
TEMP, DEG K	3010.0	2603.1	2245.2	1930.3	1653.2	1507.6	1409.6	1195.5	1008.2	844.9	703.2	580.8	2751.4
ENTHALPY (-)	88.60	116.56	140.70	161.49	179.34	188.51	194.59	207.56	218.53	227.75	235.46	241.85	106.42
CP	.6924	.6810	.6674	.6522	.6351	.6246	.6159	.5956	.5752	.5544	.5325	.5110	.6857
IMPUL OPT		155.96	212.90	251.82	280.96	294.82	303.66	321.70	336.21	347.94	357.44	365.13	124.53
IMPUL VAC		234.60	262.59	287.94	308.68	318.91	325.53	339.21	350.34	359.38	366.71	372.63	228.63
EPSILON		1.071	1.700	3.104	5.986	8.891	11.862	23.853	48.348	98.346	200.137	406.454	1.000

	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	574.3
TEMP, DEG K	3010.0	2704.1	2434.4	2286.7	2158.6	2088.4	2039.8	1928.6	1823.1	1722.2	1625.6	1533.5	2822.8
ENTHALPY (-)	88.60	117.00	142.34	165.29	186.44	197.97	205.92	223.91	240.54	255.91	270.14	283.31	106.08
X BAR	5.450	5.419	5.386	5.259	5.131	5.061	5.011	4.898	4.791	4.691	4.599	4.513	5.430
N	5.450	5.419	5.400	5.395	5.392	5.390	5.389	5.387	5.385	5.384	5.383	5.383	5.430
CP	1.0558	.9804	4.9577	5.8221	5.4946	5.1790	4.9312	4.3046	3.6988	3.1885	2.8019	2.5147	1.0094
IMPUL OPT		157.17	216.22	258.30	291.74	308.46	319.47	343.09	363.56	381.52	397.41	411.57	123.31
IMPUL VAC		237.78	268.65	298.55	324.57	338.08	347.13	366.89	384.33	399.83	413.67	426.11	230.78
EPSILON		1.082	1.768	3.409	6.983	10.771	14.783	31.950	70.030	155.051	345.975	776.960	1.000

COMPOSITION SHIFTING (MOL/100 GM)													
132.60	B	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
114.76	B*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13	B*H*O	.5695	.4622	.3517	.2603	.1833	.1451	.1208	.0732	.0401	.0196	.0086	.0035
-132.32	B*H*O2	1.1708	1.1968	1.1851	1.1049	1.0275	.9858	.9573	.8917	.8254	.7513	.6630	.5586
60.00	B*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-45.00	B*H2*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00	B*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60	B*H3*O3	.0008	.0005	.0003	.0002	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0006
5.74	B*O	.0341	.0164	.0068	.0039	.0021	.0015	.0011	.0005	.0002	.0001	.0000	.0224
-84.00	B*O2	.0222	.0129	.0066	.0047	.0033	.0027	.0024	.0016	.0010	.0006	.0003	.0002
199.30	B2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.60	B2*O2	.0720	.0611	.0471	.0308	.0183	.0128	.0097	.0044	.0017	.0005	.0001	.0000
-210.10	B2*O3	.2164	.2817	.3507	.3329	.3002	.2772	.2588	.2100	.1576	.1077	.0663	.0367
-541.69	B3*H3*O6	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10	H	.0788	.0452	.0236	.0182	.0142	.0121	.0107	.0078	.0055	.0036	.0022	.0013
9.33	H*O	.0030	.0010	.0003	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0016
.00	H2	2.9550	3.0936	3.2302	3.3411	3.4328	3.4775	3.5057	3.5600	3.5969	3.6192	3.6312	3.6368
-57.80	H2*O	.3273	.2479	.1837	.1617	.1494	.1457	.1446	.1485	.1625	.1884	.2267	.2763
59.56	O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00	O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-305.34	B2*O3/C	.0000	.0000	.0141	.1366	.2605	.3296	.3779	.4894	.5946	.6932	.7848	.8694

SYSTEM LIQUID PROPELLANT										PC 1000. PSIA										PT 0.1 PSIA																													
COMPONENT										REF. FORMULA										DENSITY										HEAT FORM										WT. 0.0									
DEG. K										DEG. K										M/CC										(KCAL/FORM.WT.)																			
2394 23942										1.4448										-44.86										70.																			
2394 23944										1.4670										-47.76										50.																			
FROZEN EXPANSION										FROZEN EXPANSION										FROZEN EXPANSION										FROZEN EXPANSION										FROZEN EXPANSION									
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PMESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA PE 0.1 PSIA
 COMPONENT TMLF FORMULA DENSITY HEAT FURN
 LEG K GM/CC (KCAL/PPM.WT.)
 29H H2O2 1.444 -44.84 72.
 29H H5OH9 0.620 17.74 27.

FLUX DENSITY = 1.054 GM/CC
 MIXTURE RATIO = 2.571 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 425.32 EU/1000PS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	564.9
TEMP, DEG K	3118.2	2702.2	2555.7	2012.6	1727.9	1578.1	1477.1	1256.2	1062.2	892.6	745.0	617.2	2554.0
ENTHALPY (-)	91.48	119.71	144.15	165.24	184.38	192.72	198.93	212.18	223.42	232.70	240.84	247.44	109.46
CP	.6240	.6730	.6579	.6453	.6284	.6183	.6101	.5895	.5693	.5484	.5269	.5052	.6771
IMPUL OPT	156.72	214.05	253.31	282.75	305.73	324.77	338.73	353.72	360.75	368.46	376.34	383.07	
IMPUL VAC	235.84	264.13	289.77	310.20	321.17	327.90	331.83	335.14	337.43	338.95	339.83	340.03	227.79
EPSILON	1.072	1.754	3.117	6.022	8.757	11.959	14.114	16.964	19.443	20.665	21.475	21.800	
	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	574.7
TEMP, DEG K	3118.2	2809.6	2520.2	2269.3	2134.4	2060.4	2009.1	1992.5	1984.2	1983.6	1990.2	1993.1	2929.6
ENTHALPY (-)	91.48	120.15	145.78	164.64	189.35	200.61	208.37	225.86	241.96	256.81	270.53	283.24	109.11
X BAK	5.308	5.271	5.245	5.208	5.078	5.007	4.956	4.841	4.732	4.630	4.535	4.448	5.284
N	5.308	5.271	5.245	5.231	5.227	5.226	5.225	5.223	5.221	5.221	5.220	5.220	5.284
CP	1.0024	1.0026	.9103	4.7192	4.5084	4.2497	4.0732	3.7053	3.4136	3.1802	2.9748	2.7529	1.0392
IMPUL OPT	157.93	217.35	259.08	291.79	308.12	318.67	324.71	326.81	327.24	327.47	327.48	327.48	123.84
IMPUL VAC	238.99	267.94	298.52	323.21	337.06	345.87	353.07	358.28	361.28	362.61	363.47	363.89	231.92
EPSILON	1.083	1.764	3.323	6.798	10.472	14.353	18.438	22.677	26.948	31.245	35.562	39.802	1.000
	COMPOSITION, SHIFTING (MOLE/100 GR)												
132.60 H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
114.76 H2O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 H2O2	.4310	.3365	.2416	.1554	.0971	.0712	.0561	.0300	.0147	.0070	.0031	.0013	.3744
-135.32 H2O2	1.2695	1.3507	1.3934	1.4006	1.3187	1.2697	1.2329	1.1387	1.0266	.9026	.7681	.6282	1.3285
66.00 H2O	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.00 H2O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 H2O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 H2O2	.0011	.0007	.0005	.0004	.0003	.0002	.0002	.0002	.0001	.0001	.0001	.0001	.0000
5.74 H2O	.0358	.0176	.0069	.0022	.0010	.0006	.0004	.0002	.0001	.0000	.0000	.0000	.0249
-44.00 H2O	.0345	.0218	.0117	.0056	.0049	.0031	.0026	.0017	.0010	.0006	.0003	.0001	.0266
199.30 H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.60 H2O2	.0414	.0320	.0219	.0124	.0059	.0036	.0025	.0019	.0013	.0008	.0004	.0002	.0358
-210.10 H2O2	.1796	.2124	.2591	.2906	.2427	.2128	.1909	.1405	.0767	.0376	.0171	.0071	.1950
-541.09 H2O2	.0000	.0000	.0000	.0001	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.1020	.0623	.0327	.0157	.0076	.0036	.0017	.0006	.0003	.0001	.0000	.0000	.0000
9.33 H2O	.0074	.0028	.0009	.0002	.0001	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0042
.00 H2	2.6818	2.8060	2.9252	3.0283	3.0944	3.1238	3.1406	3.1694	3.1856	3.1942	3.1985	3.2005	2.7566
-57.80 H2O	.5128	.4279	.3509	.2962	.2621	.2317	.2015	.1555	.0827	.0469	.0263	.0154	.4610
59.56 O	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-305.34 H2O2/L	.0000	.0000	.0000	.0228	.1488	.2191	.2685	.3823	.4897	.5905	.6846	.7721	.0000

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000 PSIA PE 3.1 PSIA
 COMPONENT REF FORMULA DENSITY HEAT FORM WT. 0/0
 DEG K GM/CC (KCAL/FORM.WT.)
 298 H2O2 1.440 -44.84 16.
 298 H5OH 0.620 47.74 24.

FULK DENSITY = 1.097 GM/CC
 MIXTURE RATIO = 5.167 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 517.45 Btu/1000MS

CHAMBER	TIMEOUT											
EXPAN. EXPANSION												
PRESSURE, PSIA	1000	392.1	152.5	65.10	25.12	14.70	10.00	5.921	1.585	.651	.251	.100
TEMP, DEG K	5290.5	2976.5	2444.5	2150.0	1854.2	1697.9	1592.4	1361.0	1156.5	976.6	819.2	682.0
ENTHALPY (-)	97.24	125.49	150.04	171.32	199.70	179.21	205.55	219.09	240.64	240.43	247.67	255.56
CP	.7555	.6549	.6435	.6290	.6151	.6027	.5955	.5752	.5546	.5335	.5126	.4911
IMPUL OPT	156.77	214.51	253.86	293.61	277.85	306.72	325.57	340.66	352.94	362.96	371.12	374.79
IMPUL VAC	246.04	264.67	270.64	312.61	322.57	327.46	345.75	355.41	364.96	372.75	379.10	389.91
EPSILON	1.073	1.712	5.141	6.091	9.079	12.145	24.574	56.129	102.637	210.272	450.365	1.000
SHIFTING EXPANSION												
PRESSURE, PSIA	1000	392.1	152.5	65.10	25.12	14.70	10.00	5.921	1.585	.651	.251	.100
TEMP, DEG K	5290.5	2976.5	2444.5	2150.0	1854.2	1697.9	1592.4	1361.0	1156.5	976.6	819.2	682.0
ENTHALPY (-)	97.24	125.49	150.04	171.32	199.70	179.21	205.55	219.09	240.64	240.43	247.67	255.56
X BAK	5.024	4.976	4.938	4.915	4.899	4.857	4.800	4.677	4.577	4.474	4.370	4.290
N	5.024	4.976	4.938	4.915	4.899	4.857	4.800	4.677	4.577	4.474	4.370	4.290
CP	1.1555	1.0364	.7129	.7265	.7078	.58612	.58221	.57210	.56064	.54556	.52621	.50064
IMPUL OPT	157.91	217.36	259.09	291.65	306.56	316.74	338.54	357.43	374.61	388.75	401.91	423.72
IMPUL VAC	249.00	264.99	270.60	312.60	322.55	327.46	345.50	355.40	364.94	372.75	379.10	389.91
EPSILON	1.073	1.765	5.504	6.567	9.910	13.567	29.575	64.279	142.615	319.414	720.769	1.000
COMPOSITION SHIFTING (MOL/100 GM)												
132.60 H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
114.76 H+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 H+H+O	.2240	.1628	.1675	.0618	.0297	.0192	.0146	.0075	.0037	.0018	.0005	.0004
-135.32 H+H+O2	1.3570	1.4575	1.5562	1.5612	1.5025	1.5652	1.4972	1.5354	1.1647	.9958	.8259	.6700
66.00 H+H+O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.00 H+H+O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 H+H+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 H+H+O3	.0018	.0015	.0010	.0009	.0010	.0010	.0009	.0007	.0005	.0004	.0003	.0002
5.74 H+O	.0317	.0352	.0065	.0018	.0053	.0001	.0001	.0000	.0000	.0000	.0000	.0000
-24.00 H+O2	.0634	.0442	.0265	.0130	.0048	.0030	.0024	.0014	.0008	.0005	.0002	.0001
199.30 H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.60 H2+O2	.0124	.0084	.0048	.0022	.0008	.0004	.0003	.0001	.0000	.0000	.0000	.0000
-210.10 H2+O3	.0240	.0116	.0115	.0122	.0127	.0115	.0112	.0104	.0072	.0044	.0028	.0019
-541.69 H3+H+O6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.0330	.0915	.0575	.0245	.0086	.0054	.0046	.0030	.0017	.0012	.0008	.0005
9.35 H+O	.0791	.0140	.0056	.0018	.0004	.0002	.0002	.0001	.0000	.0000	.0000	.0000
.00 H2	2.0509	2.1294	2.1994	2.2549	2.2924	2.3039	2.3088	2.3164	2.3205	2.3226	2.3236	2.3242
-57.80 H2+O	1.0162	.9596	.9071	.8629	.8291	.8439	.8750	.9541	1.0372	1.1211	1.2059	1.2838
59.56 O	.0011	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 O2	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-305.34 H2+O3/7	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

EPSILON	PC/P	SYSTEM LIQUID HYDROPERFLUORIC				PC 1000, PSIA				PE 10.1, PSIA			
		COMPONENT				DENSITY				HEAT FORM			
		REF. FORMULA				GM/CC				(KCAL/1000 WT.)			
		200 H2O2				1.000				-44.04			
		200 H2O				0.620				76.0			
FROZEN EXPANSION													
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PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 300. PSIA PE 0.05 PSIA

COMPONENT	TREF FORMULA DEG K	DENSITY GM/CC	HEAT FORM (KCAL/FORM.WT.)	WT. O/D
298 H2O2		1.448	-44.84	64.
298 H5OH9		0.620	+7.74	36.

BULK DENSITY = .978 GM/CC
MIXTURE RATIO = 1.778 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 343.20 EU/100GMS

CHAMBER

THROAT

	FROZEN EXPANSION											
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050
TEMP, DEG K	2566.3	2221.6	1917.6	1649.6	1535.7	1413.7	1205.9	1023.8	864.6	725.9	605.7	502.0
ENTHALPY (-)	79.95	104.34	125.42	143.59	151.18	159.19	172.53	183.88	193.49	201.59	208.37	214.01
CP	.7133	.7003	.6858	.6696	.6619	.6514	.6375	.6135	.5941	.5736	.5531	.5330
IMPUL OPT		145.65	198.88	235.28	248.92	262.55	283.79	300.69	314.29	325.30	334.24	341.50
IMPUL VAC		223.46	248.07	271.05	280.39	290.02	305.47	318.06	328.32	336.69	343.48	349.00
EPSILON		1.052	1.588	2.756	3.640	5.051	9.514	18.194	35.087	67.934	131.677	254.917

	SHIFTING EXPANSION											
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050
TEMP, DEG K	2566.3	2383.9	2247.8	2130.8	2079.0	2021.7	1918.7	1819.2	1719.6	1633.0	1568.1	1506.3
ENTHALPY (-)	79.95	104.87	127.74	148.92	158.27	168.55	186.77	203.71	219.45	234.05	247.77	260.67
X BAR	5.901	5.793	5.662	5.531	5.473	5.408	5.295	5.191	5.098	5.006	4.905	4.811
N	5.901	5.891	5.885	5.882	5.880	5.879	5.877	5.875	5.873	5.866	5.914	5.940
CP	.9799	5.9780	6.1292	5.7030	5.4316	5.0825	4.3207	3.4522	2.5384	1.7681	1.1080	0.7221
IMPUL OPT		147.23	203.89	244.95	261.03	277.62	304.84	328.12	348.36	366.14	382.09	396.50
IMPUL VAC		228.32	257.86	286.54	298.71	311.67	333.65	353.00	370.12	385.44	399.49	412.30
EPSILON		1.074	1.706	3.138	4.268	6.131	12.382	25.521	53.267	112.794	242.723	525.933

	COMPOSITION SHIFTING (MOL/100 GM)											
132.60 H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
114.76 H*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 O*H*O	1.0268	.9169	.8238	.7428	.7080	.6705	.6060	.5475	.4926	.4251	.3487	.2796
-135.32 F*H*O2	.5463	.4495	.3503	.2602	.2225	.1829	.1190	.0690	.0333	.0175	.0129	.0092
66.00 F*H2	.0003	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-45.00 H*H2*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 H*H3	.0004	.0003	.0002	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0000	.0003
-732.60 F*H3*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 H*H	.0244	.0153	.0107	.0077	.0066	.0055	.0037	.0024	.0015	.0008	.0005	.0003
-84.00 F*H2	.0039	.0021	.0013	.0007	.0006	.0004	.0002	.0001	.0000	.0000	.0000	.0002
199.30 H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.60 H2*O2	.3039	.2974	.2859	.2759	.2726	.2700	.2683	.2717	.2810	.2654	.2169	.1708
-210.10 H2*O3	.3197	.3378	.3221	.2919	.2754	.2546	.2100	.1592	.1049	.0713	.0598	.0484
-541.69 H3*H3*O6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.0339	.0233	.0180	.0142	.0127	.0110	.0082	.0058	.0038	.0025	.0019	.0015
9.33 H*H	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 H2	3.5972	3.7234	3.8329	3.9273	3.9667	4.0082	4.0766	4.1335	4.1806	4.2231	4.2640	4.3007
-57.80 H2*O	.0442	.0271	.0166	.0098	.0074	.0053	.0026	.0011	.0004	.0001	.0001	.0001
59.56 O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-305.34 H2*O3/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 B/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

SYSTEM LIQUID BIPROPELLANT										PC 300. PSIA		PF 0.05 PSIA			
COMPONENT										DENSITY		HEAT FORM		WT. 8/8	
REF FORMULA										GM/CC		[KCAL/FORM.WT.]			
DEG K															
298 H2O2										1.448		-44.84		64.	
298 H5OH9										0.620		+7.74		36.	
FROZEN EXPANSION															
C STAR = 5478.8 FT/SEC															
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/I OPT	DEL VAC	DEL VAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC		
DEG K				DEG K		/P	/P	LVL	10000	50000		LVL			
1.000	1.000	300.000	2568.3	-79.95	713										
1.000	1.741	168.472	2332.8	-96.53	705	120.1	99.1	.588	210.5	213.1	218.2	219.2	1.193	1.242	
2.000	8.849	33.980	1792.4	-133.97	679	217.3	41.5	1.221	240.8	246.2	256.7	258.7	1.364	1.466	
3.000	15.456	19.409	1613.6	-146.00	667	239.7	34.3	1.789	248.0	255.4	271.0	274.0	1.405	1.553	
4.000	23.397	12.822	1499.1	-153.57	659	253.1	30.2	2.357		259.1	279.3	283.3		1.605	
5.000	32.009	9.132	1417.1	-158.95	652	262.2	27.4	2.943			284.7	289.7		1.642	
6.000	41.541	7.222	1353.7	-163.08	646	268.9	25.7	3.555			288.5	294.6		1.669	
7.000	51.622	5.811	1302.3	-166.39	642	274.2	24.2	4.167			291.3	298.4		1.691	
8.000	61.923	4.845	1259.5	-169.13	638	278.5	23.1	4.759			293.5	301.6		1.709	
9.000	72.215	4.154	1222.8	-171.46	634	282.1	22.1	5.321			295.2	304.3		1.724	
10.000	83.144	3.608	1190.9	-173.48	631	285.2	21.3	5.862			296.5	306.5		1.737	
11.000	95.159	3.153	1162.7	-175.25	628	287.9	20.6	6.392			297.4	308.5		1.748	
12.000	107.494	2.791	1137.4	-176.84	626	290.3	20.0	6.919			298.1	310.3		1.758	
13.000	120.028	2.499	1114.7	-178.26	623	292.4	19.4	7.437			298.6	311.9		1.767	
14.000	132.692	2.262	1094.0	-179.54	621	294.4	19.0	7.944			299.0	313.3		1.775	
15.000	145.571	2.065	1075.1	-180.71	619	296.1	18.5	8.467			299.3	314.6		1.782	
16.000	157.816	1.901	1057.7	-181.79	617	297.7	18.1	8.934			299.5	315.8		1.789	
17.000	170.237	1.762	1041.6	-182.79	615	299.1	17.8	9.400			299.7	316.9		1.795	
18.000	182.511	1.644	1026.6	-183.71	614	300.4	17.4	9.855			299.8	317.9		1.801	
19.000	196.377	1.528	1012.5	-184.57	612	301.7	17.1	10.307			299.9	318.8		1.806	
20.000	210.401	1.422	999.3	-185.37	611	302.8	16.8	10.754			299.9	319.7		1.811	
21.000	225.569	1.329	987.0	-186.13	609	303.9	16.6	12.465			299.9	320.5		1.816	
22.000	240.647	1.247	975.1	-186.84	608	304.9	16.3	13.085			299.9	321.3		1.820	
23.000	255.742	1.173	964.2	-187.51	607	305.9	16.1	13.708			299.9	322.0		1.824	
24.000	271.254	1.107	953.8	-188.15	605	306.8	15.9	14.326			299.9	322.7		1.828	
25.000	286.443	1.047	943.8	-188.75	604	307.7	15.6	14.939			299.9	323.3		1.832	
26.000	301.857	.994	934.3	-189.32	603	308.5	15.4	15.545			299.9	323.9		1.835	
27.000	317.318	.945	925.1	-189.86	602	309.2	15.3	16.143			299.9	324.5		1.838	
28.000	332.858	.901	916.6	-190.38	601	310.0	15.1	16.734			299.9	325.0		1.842	
29.000	348.475	.861	908.4	-190.88	600	310.7	14.9	17.315			299.9	325.6		1.845	
30.000	363.709	.825	900.4	-191.36	599	311.3	14.8	17.888			299.9	326.1		1.847	
31.000	379.055	.791	892.8	-191.81	598	312.0	14.6	18.448			299.9	326.6		1.850	
32.000	394.405	.761	885.5	-192.25	597	312.7	14.5	19.000			299.9	327.0		1.853	
33.000	409.963	.733	878.5	-192.67	596	313.1	14.3	19.542			299.9	327.5		1.855	
34.000	424.857	.706	871.7	-193.07	595	313.7	14.2	20.075			299.9	327.9		1.858	
35.000	439.963	.682	865.1	-193.46	594	314.2	14.0	20.598			299.9	328.3		1.860	
36.000	454.167	.658	858.8	-193.84	593	314.8	13.9	21.111			299.9	328.7		1.862	
37.000	468.749	.632	852.7	-194.20	592	315.1	13.8	21.616			299.9	329.1		1.864	
38.000	482.504	.609	846.7	-194.55	592	315.7	13.7	22.115			299.9	329.4		1.866	
39.000	496.119	.588	841.0	-194.89	591	316.2	13.6	22.608			299.9	329.8		1.868	
40.000	509.682	.568	835.4	-195.22	590	316.7	13.5	23.100			299.9	330.1		1.870	
41.000	523.681	.544	830.0	-195.54	589	317.1	13.4	23.583			299.9	330.5		1.872	
42.000	537.655	.521	824.8	-195.85	589	317.5	13.3	24.059			299.9	330.8		1.874	
43.000	551.442	.504	819.7	-196.14	588	317.9	13.2	24.527			299.9	331.1		1.876	
44.000	565.147	.488	814.8	-196.43	587	318.3	13.1	24.989			299.9	331.4		1.878	
45.000	578.664	.473	810.0	-196.72	586	318.7	13.0	25.447			299.9	331.7		1.879	
46.000	592.117	.459	805.1	-197.00	586	319.1	12.9	25.899			299.9	332.0		1.881	
47.000	605.495	.446	800.7	-197.26	585	319.5	12.8	26.345			299.9	332.2		1.882	
48.000	618.911	.433	796.3	-197.52	584	319.8	12.7	26.785			299.9	332.5		1.884	
49.000	632.365	.421	792.0	-197.77	584	320.2	12.6	27.220			299.9	332.8		1.885	
50.000	645.747	.410	787.7	-198.01	583	320.5	12.5	27.651			299.9	333.0		1.887	
51.000	659.054	.400	783.4	-198.25	582	320.9	12.4	28.077			299.9	333.2		1.888	
52.000	672.284	.390	779.1	-198.48	581	321.2	12.3	28.500			299.9	333.4		1.889	
53.000	685.434	.380	774.8	-198.71	580	321.5	12.2	28.919			299.9	333.6		1.890	
54.000	698.504	.370	770.5	-198.94	579	321.8	12.1	29.334			299.9	333.8		1.891	
55.000	711.494	.360	766.2	-199.17	578	322.1	12.0	29.745			299.9	334.0		1.892	
56.000	724.404	.350	761.9	-199.39	577	322.4	11.9	30.152			299.9	334.2		1.893	
57.000	737.234	.340	757.6	-199.61	576	322.7	11.8	30.555			299.9	334.4		1.894	
58.000	750.084	.330	753.3	-199.83	575	323.0	11.7	30.954			299.9	334.6		1.895	
59.000	762.854	.320	749.0	-200.05	574	323.3	11.6	31.349			299.9	334.8		1.896	
60.000	775.544	.310	744.7	-200.27	573	323.6	11.5	31.740			299.9	335.0		1.897	
61.000	788.154	.300	740.4	-200.49	572	323.9	11.4	32.127			299.9	335.2		1.898	
62.000	800.684	.290	736.1	-200.71	571	324.2	11.3	32.510			299.9	335.4		1.899	
63.000	813.134	.280	731.8	-200.93	570	324.5	11.2	32.889			299.9	335.6		1.900	
64.000	825.504	.270	727.5	-201.15	569	324.8	11.1	33.264			299.9	335.8		1.901	
65.000	837.794	.260	723.2	-201.37	568	325.1	11.0	33.635			299.9	336.0		1.902	
66.000	850.004	.250	718.9	-201.59	567	325.4	10.9	34.002			299.9	336.2		1.903	
67.000	862.134	.240	714.6	-201.81	566	325.7	10.8	34.365			299.9	336.4		1.904	
68.000	874.184	.230	710.3	-202.03	565	326.0	10.7	34.724			299.9	336.6		1.905	
69.000	886.154	.220	706.0	-202.25	564	326.3	10.6	35.079			299.9	336.8		1.906	
70.000	898.044	.210	701.7	-202.47	563	326.6	10.5	35.430			299.9	337.0		1.907	
71.000	909.854	.200	697.4	-202.69	562	326.9	10.4	35.777			299.9	337.2		1.908	
72.000	921.584	.190	693.1	-202.91	561	327.2	10.3	36.120			299.9	337.4		1.909	
73.000	933.234	.180	688.8	-203.13	560	327.5	10.2	36.459			299.9	337.6		1.910	
74.000	944.804	.170	684.5	-203.35	559	327.8	10.1	36.794			299.9	337.8		1.911	
75.000	956.254	.160	680.2	-203.57	558	328.1	10.0	37.125			299.9	338.0		1.912	
76.000	967.584	.150	675.9	-203.79	557	328.4	9.9	37.452			299.9	338.2		1.913	
77.000	978.804	.140	671.6	-204.01	556	328.7	9.8	37.775			299.9	338.4		1.914	
78.000	989.914	.130	667.3	-204.23	555	329.0	9.7	38.094			299.9	338.6		1.915	
79.000	1000.914	.120	663.0	-204.45	554	329.3	9.6	38.409			299.9	338.8		1.916	
80.000	1011.804	.110	658.7	-204.67	553	329.6	9.5	38.720			299.9	339.0		1.917	
81.000	1022.604	.100	654.4	-204.89	552	329.9	9.4	39.027			299.9	339.2		1.918	
82.000	1033.304	.090	650.1	-205.11	551	330.2	9.3	39.330			299.9	339.4		1.919	
83.000	1043.904	.080	645.8	-205.33	550	330.5	9.2	39.629			299.9	3			

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 300. PSIA PE 0.05 PSIA

COMPONENT	TREF FORMULA DEG K	DENSITY GM/CC	HEAT FORM (KCAL/FORM.WT.)	WT. O/O
298 H2O2		1.448	-44.84	68.
298 H5OH9		0.620	+7.74	32.

BULK DENSITY = 1.014 GM/CC
MIXTURE RATIO = 2.125 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
CHAMBER ENTROPY 340.76 EU/100GMS

	CHAMBER										THROAT									
	FROZEN EXPANSION																			
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	170.1							
TEMP, DEG K	2845.2	2473.3	2144.4	1853.6	1729.6	1596.7	1369.7	1169.3	993.3	839.1	704.5	587.5	2597.4							
ENTHALPY (-)	85.72	111.53	133.94	153.35	161.48	170.09	184.49	196.81	207.30	216.19	223.68	229.95	102.96							
CP	.6994	.6883	.6746	.6595	.6520	.6433	.6243	.6053	.5860	.5664	.5458	.5253	.6920							
IMPUL OPT	149.85	204.83	242.56	256.73	270.93	293.13	310.88	325.23	336.91	346.44	354.22	362.29	122.49							
IMPUL VAC	230.09	255.72	279.71	289.49	299.58	315.85	329.17	340.08	349.02	356.33	362.29	362.29	225.58							
EPSILON	1.053	1.595	2.779	3.674	5.114	9.678	18.595	36.038	70.141	136.688	266.106	1.000								
	SHIFTING EXPANSION																			
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	173.5							
TEMP, DEG K	2845.2	2576.3	2324.9	2188.2	2137.9	2083.0	1986.5	1897.3	1814.2	1735.9	1661.3	1588.9	2673.8							
ENTHALPY (-)	85.72	111.97	135.58	157.00	166.48	176.89	195.41	212.68	228.83	243.36	258.14	271.44	102.57							
X BAR	5.623	5.588	5.565	5.452	5.392	5.325	5.204	5.090	4.982	4.878	4.781	4.689	5.599							
N	5.623	5.588	5.565	5.559	5.558	5.556	5.553	5.552	5.550	5.549	5.548	5.547	5.599							
CP	1.1310	1.0382	.9596	8.6485	8.6006	8.5092	8.2216	7.7774	7.1664	6.3947	5.4850	4.4904	1.0720							
IMPUL OPT	151.13	208.27	249.03	265.07	281.63	308.91	332.34	352.85	371.03	387.29	401.96	412.08								
IMPUL VAC	233.48	261.97	290.44	302.66	315.68	337.95	357.48	375.00	390.77	405.02	417.98	227.98								
EPSILON	1.063	1.655	3.046	4.152	5.978	12.124	25.127	52.859	112.431	241.115	520.156	1.000								
	COMPOSITION SHIFTING (MOL/100 GM)																			
132.60 H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
114.76 H*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 H*H*O	.7023	.5999	.4887	.3984	.3615	.3218	.2543	.1953	.1444	.1013	.0662	.0391	.6390							
-135.32 H*H*O2	.9914	.9740	.9215	.8287	.7856	.7389	.6579	.5858	.5231	.4696	.4254	.3892	.9844							
56.00 H*H2	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
-45.00 H*H2*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
18.00 H*H3	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
-238.60 H*H3*O3	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001							
5.74 H*O	.0459	.0231	.0097	.0059	.0049	.0040	.0026	.0016	.0010	.0005	.0003	.0001	.0304							
-84.00 H*O2	.0261	.0112	.0052	.0034	.0030	.0025	.0018	.0013	.0009	.0006	.0004	.0003	.0141							
149.30 H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
-111.60 H2*O2	.1177	.1105	.0985	.0787	.0697	.0601	.0443	.0310	.0202	.0120	.0062	.0027	.1136							
-210.10 H2*O3	.2667	.3517	.4553	.4624	.4534	.4417	.4148	.3821	.3431	.2981	.2472	.1915	.3187							
-541.69 H3*H3*O6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
52.10 H	.0895	.0512	.0254	.0189	.0173	.0156	.0127	.0103	.0082	.0064	.0049	.0036	.0639							
9.33 H*O	.0016	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0007							
.00 H2	3.2023	3.3377	3.4774	3.5918	3.6388	3.6891	3.7743	3.8480	3.9109	3.9631	4.0048	4.0361	3.2870							
-57.80 H2*O	.1834	.1279	.0831	.0636	.0575	.0513	.0418	.0348	.0298	.0268	.0255	.0265	.1473							
59.56 O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
-305.34 H2*O3/C	.0000	.0000	.0000	.1071	.1658	.2310	.3490	.4613	.5684	.6703	.7668	.8578	.0000							

SYSTEM LIQUID BIPHORELLANT										PC 300. PSIA		PE 0.05 PSIA			
COMPONENT		REF. FORMULA		DENSITY		HEAT FORM		WT. 0/0							
		DEG. K		GM/CM ³		[KCAL/FORM.WT.]									
		298 H2O2		1.448		-44.84		68.							
		298 B5MH9		0.620		+7.74		32.							
FROZEN EXPANSION															
C STAR = 5849.2 FT/SEC															
I SEA I AT I AT I VAC CF SEA CF VAC															
LVL 10000 50000 LVL															
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP	CAL/I	OPT	DEL VAC	DEL VAC						
			DEG. K	KCAL/100GM	GM DEG			/P							
1.000	1.000	100.000	2845.2	-85.72	.699	.672	122.5	103.1	.606	216.7	219.4	224.5	225.6	1.192	1.241
2.000	1.764	170.107	2547.4	-102.96	.672	122.5	103.1	.606	216.7	219.4	224.5	225.6	1.192	1.241	1.466
3.000	8.736	34.342	2012.0	-142.84	.668	223.4	43.7	1.757	246.1	253.7	264.4	266.6	1.365	1.407	1.596
4.000	15.295	194.066	1816.5	-155.67	.657	266.7	35.8	1.822	255.7	261.8	279.4	282.5	1.407	1.450	1.607
5.000	23.038	13.022	1694.5	-163.77	.650	260.6	31.6	2.427	267.3	288.1	292.2				1.644
6.000	31.474	9.532	1605.4	-169.53	.644	270.0	28.9	3.032	293.8	298.9					1.672
7.000	40.741	7.364	1536.3	-173.96	.639	277.1	26.9	3.659	297.8	304.0					1.695
8.000	50.576	5.932	1480.4	-177.52	.634	282.6	25.5	4.291	300.7	308.1					1.713
9.000	60.616	4.946	1433.7	-180.47	.630	287.1	24.3	4.904	303.0	311.4					1.728
10.000	70.701	4.243	1393.8	-182.98	.626	290.9	23.3	5.488	304.8	314.2					1.741
11.000	81.121	3.698	1358.9	-185.16	.623	294.1	22.5	6.073	306.2	316.6					1.753
12.000	92.764	3.234	1328.0	-187.08	.621	297.0	21.7	6.721	307.2	318.7					1.763
13.000	104.757	2.888	1300.4	-188.79	.618	299.5	21.1	7.367	308.0	320.4					1.772
14.000	116.913	2.566	1275.5	-190.33	.616	301.7	20.5	8.006	308.6	322.2					1.781
15.000	129.141	2.322	1252.8	-191.72	.614	303.7	20.0	8.633	309.0	323.7					1.788
16.000	141.481	2.120	1232.0	-193.00	.612	305.5	19.6	9.262	309.3	325.1					1.795
17.000	153.711	1.952	1212.9	-194.17	.610	307.2	19.2	9.833	309.6	326.4					1.801
18.000	165.834	1.804	1195.1	-195.24	.608	308.7	18.8	10.402	309.8	327.5					1.807
19.000	177.817	1.687	1178.6	-196.25	.606	310.1	18.5	10.951		328.6					1.813
20.000	190.466	1.575	1163.2	-197.18	.605	311.4	18.2	11.529		329.6					1.818
21.000	204.457	1.467	1148.7	-198.06	.603	312.6	17.9	12.133		330.5					1.823
22.000	218.694	1.372	1135.1	-198.88	.602	313.8	17.6	12.766		331.3					1.827
23.000	233.124	1.281	1122.2	-199.65	.600	314.8	17.3	13.433		332.2					1.831
24.000	247.730	1.211	1110.0	-200.38	.599	315.8	17.1	14.105		332.9					1.835
25.000	262.472	1.143	1098.5	-201.07	.598	316.8	16.9	14.765		333.6					1.839
26.000	277.316	1.082	1087.5	-201.73	.597	317.7	16.6	15.419		334.3					1.843
27.000	292.218	1.027	1077.0	-202.35	.596	318.5	16.4	16.078		335.0					1.846
28.000	307.254	.971	1067.0	-202.95	.594	319.4	16.2	16.629		335.6					1.849
29.000	322.447	.931	1057.5	-203.52	.593	320.1	16.1	17.243		336.2					1.852
30.000	337.774	.890	1048.4	-204.06	.592	320.9	15.9	17.846		336.7					1.855
31.000	353.135	.852	1039.6	-204.58	.591	321.6	15.7	18.446		337.3					1.858
32.000	368.537	.817	1031.2	-205.07	.590	322.2	15.6	19.031		337.8					1.861
33.000	383.977	.785	1023.1	-205.55	.590	322.9	15.4	19.608		338.3					1.863
34.000	399.453	.756	1015.3	-206.01	.589	323.5	15.3	20.175		338.8					1.866
35.000	414.970	.729	1007.4	-206.45	.588	324.1	15.1	20.732		339.2					1.868
36.000	430.524	.704	1000.0	-206.88	.587	324.7	15.0	21.280		339.6					1.871
37.000	446.112	.681	993.5	-207.29	.586	325.2	14.9	21.818		340.1					1.873
38.000	461.735	.656	986.8	-207.68	.585	325.7	14.7	22.455		340.5					1.875
39.000	477.499	.632	980.2	-208.07	.584	326.3	14.6	23.087		340.9					1.877
40.000	493.312	.610	973.8	-208.44	.584	326.7	14.5	23.710		341.2					1.879
41.000	509.176	.589	967.7	-208.80	.583	327.2	14.4	24.328		341.6					1.881
42.000	525.099	.570	961.7	-209.15	.582	327.7	14.3	24.947		342.0					1.883
43.000	541.076	.552	955.9	-209.49	.582	328.1	14.2	25.567		342.6					1.885
44.000	557.107	.534	950.3	-209.81	.581	328.5	14.1	26.182		343.0					1.888
45.000	573.192	.518	944.8	-210.11	.580	329.0	14.0	26.795		343.3					1.890
46.000	589.332	.503	939.4	-210.44	.579	329.4	13.9	27.403		343.6					1.891
47.000	605.527	.487	934.2	-210.74	.578	329.7	13.7	28.006		343.9					1.893
48.000	621.777	.471	929.1	-211.01	.578	330.2	13.6	28.606		344.2					1.895
49.000	638.081	.456	924.1	-211.27	.577	330.6	13.5	29.202		344.4					1.896
50.000	654.441	.441	919.4	-211.51	.576	331.1	13.4	29.797		344.7					1.897
51.000	670.856	.426	914.8	-211.74	.576	331.3	13.4	30.392		344.7					1.898
52.000	687.326	.411	910.4	-211.96	.575	331.7	13.3	30.987		344.7					1.899
53.000	703.851	.396	906.1	-212.17	.575	332.0	13.2	31.582		344.7					1.900
54.000	720.431	.381	901.9	-212.37	.574	332.4	13.1	32.177		344.7					1.901
55.000	737.066	.366	897.8	-212.56	.574	332.7	13.0	32.772		344.7					1.902
56.000	753.756	.351	893.8	-212.74	.573	333.1	12.9	33.367		344.7					1.903
57.000	770.501	.336	889.9	-212.91	.573	333.4	12.8	33.962		344.7					1.904
58.000	787.301	.321	886.1	-213.07	.572	333.7	12.7	34.557		344.7					1.905
59.000	804.156	.306	882.4	-213.22	.572	334.0	12.6	35.152		344.7					1.906
60.000	821.066	.291	878.8	-213.37	.571	334.3	12.5	35.747		344.7					1.907
61.000	838.031	.276	875.3	-213.51	.571	334.6	12.4	36.342		344.7					1.908
62.000	855.051	.261	871.9	-213.64	.570	334.9	12.3	36.937		344.7					1.909
63.000	872.126	.246	868.6	-213.77	.570	335.2	12.2	37.532		344.7					1.910
64.000	889.256	.231	865.4	-213.89	.569	335.5	12.1	38.127		344.7					1.911
65.000	906.441	.216	862.3	-214.01	.569	335.8	12.0	38.722		344.7					1.912
66.000	923.681	.201	859.3	-214.12	.568	336.1	11.9	39.317		344.7					1.913
67.000	940.976	.186	856.4	-214.23	.568	336.4	11.8	39.912		344.7					1.914
68.000	958.326	.171	853.6	-214.33	.567	336.7	11.7	40.507		344.7					1.915
69.000	975.731	.156	850.9	-214.43	.567	337.0	11.6	41.102		344.7					1.916
70.000	993.191	.141	848.3	-214.52	.566	337.3	11.5	41.697		344.7					1.917
71.000	1010.706	.126	845.8	-214.61	.566	337.6	11.4	42.292		344.7					1.918
72.000	1028.276	.111	843.4	-214.69	.565	337.9	11.3	42.887		344.7					1.919
73.000	1045.901	.096	841.1	-214.77	.565	338.2	11.2	43.482		344.7					1.920
74.000	1063.581	.081	838.9	-214.84	.564	338.5	11.1	44.077		344.7					1.921
75.000	1081.316	.066	836.8	-214.91	.564	338.8	11.0	44.672		344.7					1.922
76.000	1099.106	.051	834.8	-214.97	.563	339.1	10.9	45.267		344.7					1.923
77.000	1116.951	.036	832.9	-215.03	.563	339.4	10.8	45.862		344.7					1.924
78.000	1134.791	.021	831.0	-215.08	.562	339.7	10.7	46.457		344.7					1.925
79.000	1152.626	.006	829.2	-215.13	.562	340.0	10.6	47.052		344.7					1.926
80.000	1170.466	.000	827.4	-215.18	.561	340.3	10.5	47.647		344.7					1.927
81.000	1188.311	.000	825.6	-215.23	.561	340.6	10.4	48.242		344.7					1.928
82.000	1206.156	.000	823.8	-215.28	.560	340.9	10.3	48.837		344.7					1.929
83.000	1224.001	.000	822.0	-215.33	.560	341.2	10.2	49.432		344.7					1.930
84.000	1241.846	.000	820.2	-215.38	.559	341.5	10.1	50.027		344.7					1.931
85.000	1259.691	.000	818.4	-215.43	.559	341.8	10.0	50.622		344.7					1.932
86.000	1277.536	.000	816.6	-215.48	.558	342.1	9.9	51.217		344.7					1.933

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 300. PSIA PE 0.05 PSIA

COMPONENT	TREF FORMULA DEG K	DENSITY GM/CC	HEAT FORM (KCAL/FORM.WT.)	WT. O/O
298 H2*O2		1.448	-44.84	70.
298 B5*H9		0.620	+7.74	30.

BULK DENSITY = 1.034 GM/CC
MIXTURE RATIO = 2.333 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 338.67 EU/100GMS

CHAMBER	FROZEN EXPANSION												THROAT
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	169.9
TEMP, DEG K	2957.5	2575.4	2237.2	1937.7	1809.9	1672.6	1438.1	1230.7	1047.8	887.3	746.8	624.5	2702.7
ENTHALPY (-)	88.60	114.81	137.61	157.39	165.69	174.49	189.23	201.87	212.66	221.82	229.56	236.05	106.13
CP	.6915	.6799	.6672	.6528	.6455	.6367	.6189	.5997	.5805	.5609	.5405	.5198	.6844
IMPUL OPT	151.01	206.49	244.63	258.97	273.36	295.88	313.91	328.52	340.44	350.19	358.16	366.44	123.50
IMPUL VAC	231.93	257.90	282.22	292.13	302.39	318.94	332.51	343.66	352.81	360.31	366.44	372.34	227.34
EPSILON	1.054	1.598	2.788	3.693	5.140	9.745	18.762	36.432	71.056	138.775	270.786	1.000	

CHAMBER	SHIFTING EXPANSION												THROAT
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	172.8
TEMP, DEG K	2957.5	2689.6	2436.9	2196.3	2133.2	2075.9	1974.2	1878.7	1788.3	1701.9	1618.9	1539.1	2785.6
ENTHALPY (-)	88.60	115.27	139.32	160.95	170.33	180.61	198.89	215.87	231.67	246.38	260.09	272.88	105.83
X BAR	5.488	5.445	5.415	5.396	5.346	5.279	5.157	5.041	4.931	4.827	4.730	4.639	5.460
N	5.488	5.445	5.415	5.396	5.346	5.279	5.157	5.041	4.931	4.827	4.730	4.639	5.460
CP	1.2015	1.0946	.9924	.9014	7.3294	7.0479	6.4111	5.6898	4.9533	4.2742	3.7041	3.2635	1.1347
IMPUL OPT	152.32	210.05	250.89	266.65	282.93	309.75	332.74	352.79	370.50	386.25	400.40	422.42	
IMPUL VAC	235.44	264.36	291.73	303.63	316.41	338.16	357.35	374.40	389.66	403.39	415.82	429.82	
EPSILON	1.064	1.659	2.978	4.047	5.827	11.801	24.392	51.128	108.260	231.026	496.047	1.000	

COMPOSITION SHIFTING (MOLE/100 GM)													
132.60 B	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
114.76 B*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 B*H*O	.5428	.4519	.3547	.2556	.2196	.1841	.1268	.0820	.0492	.0271	.0137	.0063	.4859
-135.32 B*H*O2	1.1660	1.1911	1.1907	1.1648	1.1319	1.0928	1.0264	.9673	.9124	.8561	.7920	.7140	1.1847
66.00 B*H2	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.00 B*H2*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 B*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 B*H3*O3	.0002	.0001	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
5.74 B*O	.0512	.0272	.0120	.0041	.0030	.0022	.0012	.0006	.0003	.0001	.0000	.0000	.0349
-44.00 B*O2	.0346	.0217	.0117	.0052	.0043	.0036	.0027	.0019	.0013	.0009	.0006	.0003	.0261
199.30 B2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.60 B2*O2	.0684	.0594	.0479	.0343	.0279	.0214	.0122	.0062	.0027	.0010	.0003	.0001	.0630
-210.10 B2*O3	.2214	.2818	.3547	.4380	.4323	.4109	.3634	.3080	.2474	.1861	.1296	.0830	.2583
-541.69 B3*H3*O6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.1229	.0763	.0415	.0190	.0162	.0143	.0112	.0086	.0063	.0045	.0030	.0020	.0921
9.33 H*O	.0044	.0016	.0005	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0024
.00 H2	2.9621	3.0895	3.2175	3.3420	3.3860	3.4289	3.4970	3.5491	3.5864	3.6109	3.6256	3.6337	3.0426
-57.80 H2*O	.3143	.2447	.1834	.1330	.1249	.1203	.1156	.1168	.1245	.1401	.1649	.2001	.2694
59.56 O	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-305.34 B2*O3/C	.0000	.0000	.0000	.0000	.0477	.1135	.2330	.3471	.4555	.5580	.6541	.7438	.0000

SYSTEM LIQUID BIPROPELLANT										PC 300. PSIA		PE 0.05 PSIA			
COMPONENT		TREF	FORMULA	DENSITY		HEAT FORM		WT. G/G							
		DEG K		GM/CC		(KCAL/FORM.WT.)									
298 H2+O2				1.448		-44.84		70.							
298 O5+H9				0.620		+7.74		30.							
FROZEN EXPANSION															
C STAR = 5897.7 FT/SEC															
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DEL VAC	DEL VAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC	
			DEG K	KCAL/100GM	GM DEG		/P	/P	LVL	10000	50000		LVL		
1.000	1.000	300.000	2957.5	-88.60	1.202										
1.000	1.765	169.944	2702.7	-106.13	1.135	122.4	103.8	621	218.4	221.1	226.3	227.3	1.191	1.240	
2.000	8.697	34.493	2102.3	-146.58	1.061	225.1	43.7	1.267	250.2	255.8	266.6	268.8	1.365	1.466	
3.000	15.174	19.770	1903.1	-159.64	1.051	248.6	36.3	1.837	257.9	266.1	281.8	284.9	1.407	1.556	
4.000	22.893	13.104	1775.5	-167.91	1.043	282.7	32.1	2.447	269.6	290.6	294.7			1.408	
5.000	31.262	9.596	1683.6	-173.79	1.037	322.2	29.3	3.058		296.4	301.4			1.645	
6.000	40.428	7.421	1612.4	-178.31	1.033	379.4	27.4	3.689		300.5	306.8			1.673	
7.000	50.166	5.980	1554.7	-181.95	1.028	405.0	25.9	4.326		303.5	310.9			1.696	
8.000	60.131	4.989	1506.5	-184.97	1.025	489.6	24.7	4.946		305.8	314.2			1.716	
9.000	70.112	4.279	1465.3	-187.54	1.021	593.4	23.7	5.536		307.4	317.1			1.730	
10.000	80.324	3.735	1429.3	-189.77	1.018	696.7	22.9	6.120		309.1	319.5			1.743	
11.000	91.826	3.267	1397.4	-191.74	1.015	799.6	22.1	6.774		310.1	321.7			1.755	
12.000	103.648	2.894	1368.9	-193.49	1.013	902.1	21.5	7.426		310.9	323.6			1.765	
13.000	115.680	2.593	1343.1	-195.06	1.010	1004.3	20.9	8.071		311.5	325.3			1.775	
14.000	127.818	2.347	1319.7	-196.49	1.008	1106.4	20.4	8.704		312.0	326.8			1.783	
15.000	139.975	2.143	1298.2	-197.80	1.006	1208.2	20.0	9.321		312.3	328.2			1.790	
16.000	152.078	1.973	1278.4	-199.00	1.004	1309.9	19.6	9.919		312.6	329.5			1.797	
17.000	164.077	1.828	1260.0	-200.10	1.003	1411.5	19.2	10.496		312.7	330.7			1.804	
18.000	175.941	1.705	1242.9	-201.13	1.001	1512.9	18.8	11.053						1.810	
19.000	188.125	1.595	1226.9	-202.09	1.000	1614.2	18.5	11.618						1.815	
20.000	201.903	1.486	1211.9	-202.99	1.000	1715.5	18.2	12.267						1.820	
21.000	215.920	1.389	1197.8	-203.83	1.000	1816.6	17.9	12.918						1.825	
22.000	230.141	1.304	1184.4	-204.63	1.000	1917.7	17.7	13.568						1.830	
23.000	244.534	1.227	1171.8	-205.38	1.000	2018.8	17.4	14.216						1.834	
24.000	259.064	1.158	1159.8	-206.09	1.000	2119.7	17.2	14.862						1.839	
25.000	273.701	1.096	1148.5	-206.76	1.000	2220.6	17.0	15.502						1.842	
26.000	288.416	1.040	1137.6	-207.41	1.000	2321.5	16.8	16.138						1.845	
27.000	303.181	0.990	1127.2	-208.02	1.000	2422.3	16.6	16.766						1.849	
28.000	317.970	0.943	1117.3	-208.60	1.000	2523.1	16.4	17.388						1.852	
29.000	332.761	0.902	1107.9	-209.16	1.000	2623.9	16.2	18.000						1.855	
30.000	347.534	0.863	1098.8	-209.69	1.000	2724.6	16.1	18.604						1.858	
31.000	362.277	0.828	1090.0	-210.20	1.000	2825.3	15.9	19.199						1.861	
32.000	376.962	0.796	1081.6	-210.69	1.000	2925.9	15.7	19.784						1.864	
33.000	391.592	0.766	1073.5	-211.17	1.000	3026.5	15.6	20.359						1.866	
34.000	406.155	0.739	1065.7	-211.62	1.000	3127.1	15.5	20.925						1.869	
35.000	420.646	0.713	1058.2	-212.06	1.000	3227.7	15.3	21.481						1.871	
36.000	435.063	0.689	1050.9	-212.48	1.000	3328.3	15.2	22.027						1.874	
37.000	450.070	0.666	1043.9	-212.89	1.000	3428.8	15.1	22.628						1.876	
38.000	464.751	0.642	1037.1	-213.29	1.000	3529.4	14.9	23.274						1.878	
39.000	479.144	0.620	1030.5	-213.67	1.000	3629.9	14.8	23.927						1.880	
40.000	493.171	0.599	1024.2	-214.04	1.000	3730.3	14.7	24.571						1.882	
41.000	507.794	0.579	1017.4	-214.40	1.000	3830.7	14.6	25.219						1.884	
42.000	522.529	0.560	1011.4	-214.74	1.000	3931.3	14.5	25.868						1.886	
43.000	537.466	0.543	1005.9	-215.08	1.000	4031.7	14.4	26.516						1.888	
44.000	552.365	0.526	1000.2	-215.41	1.000	4132.1	14.3	27.163						1.890	
45.000	567.027	0.510	994.7	-215.73	1.000	4232.6	14.2	27.808						1.892	
46.000	581.541	0.495	989.3	-216.04	1.000	4333.0	14.1	28.452						1.893	
47.000	595.756	0.481	984.0	-216.34	1.000	4433.4	14.0	29.094						1.895	
48.000	610.177	0.466	978.9	-216.63	1.000	4533.7	13.9	29.734						1.897	
49.000	624.875	0.455	973.9	-216.92	1.000	4634.1	13.8	30.372						1.898	
50.000	639.711	0.445	969.0	-217.21	1.000	4734.5	13.7	31.006						1.900	
50.000	654.711	0.435	964.2	-217.50	1.000	4834.9	13.6	31.638						1.901	
SHIFTING EXPANSION															
C STAR = 6000.1 FT/SEC															
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DEL VAC	DEL VAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC	
			DEG K	KCAL/100GM	GM DEG		/P	/P	LVL	10000	50000		LVL		
1.000	1.000	300.000	2957.5	-88.60	1.202										
1.000	1.736	172.771	2785.6	-105.83	1.135	122.4	107.4	622	220.7	223.4	228.8	229.8	1.232	1.183	
2.000	8.611	37.493	2165.9	-147.14	1.061	226.1	46.0	1.280	255.3	261.0	271.9	274.1	1.369	1.470	
3.000	13.741	21.716	1978.9	-159.69	1.051	249.9	38.9	1.848	263.6	272.9	288.9	291.0	1.419	1.566	
4.000	20.117	14.713	1795.2	-167.99	1.043	286.1	37.1	2.488	268.6	278.6	298.3	303.1	1.430	1.626	
5.000	26.817	11.174	1698.4	-176.49	1.037	329.4	34.8	3.116		279.2	305.9	311.2		1.702	
6.000	34.731	8.501	1607.1	-181.41	1.033	384.2	33.2	3.731		310.1	317.4			1.702	
7.000	43.114	6.299	1548.4	-184.56	1.028	439.4	32.0	4.361		315.0	322.4			1.729	
8.000	52.047	5.176	1497.9	-187.04	1.025	494.6	30.5	4.992		316.1	326.7			1.750	
9.000	60.580	4.321	1452.6	-189.11	1.021	550.1	30.1	5.665		320.6	330.2			1.771	
10.000	69.013	3.687	1417.1	-191.77	1.017	605.9	30.3	6.282		322.7	333.4			1.788	
11.000	77.576	3.194	1383.8	-194.15	1.013	662.7	29.3	6.877		324.4	336.2			1.803	
12.000	86.181	2.812	1351.9	-196.33	1.010	720.4	28.3	7.459		325.9	338.6			1.817	
13.000	94.812	2.484	1321.5	-198.25	1.007	778.9	27.4	8.029		327.0	340.9			1.828	
14.000	103.470	2.218	1292.0	-200.04	1.004	838.1	26.5	8.579		327.9	342.9			1.839	
15.000	112.146	1.999	1263.7	-201.68	1.001	898.1	25.7	9.112		328.7	344.8			1.849	
16.000	120.836	1.812	1236.4	-203.20	1.000	958.6	25.0	9.636		329.4	346.6			1.858	
17.000	129.536	1.650	1210.2	-204.61	1.000	1019.4	24.3	10.155		330.0	348.2			1.867	
18.000	138.246	1.502	1185.0	-205.91	1.000	1080.6	23.6	10.669		330.6	349.7			1.875	
19.000	146.966	1.367	1160.7	-207.11	1.000	1142.1	23.0	11.177		331.1	351.1			1.882	
20.000	155.686	1.244	1137.4	-208.21	1.000	1203.9	22.4	11.680		331.6	352.4			1.890	
21.000	164.406	1.131	1114.9	-209.21	1.000	1265.9	21.8	12.177		332.0	353.6			1.898	
22.000	173.126	1.028	1093.4	-210.11	1.000	1328.1	21.2	12.670		332.4	354.8			1.906	
23.000	181.846	0.935	1072.9	-210.91	1.000	1390.3	20.6	13.159		332.8	355.9			1.914	
24.000	190.566	0.852	1053.4	-211.61	1.000	1452.5	20.0	13.648		333.1	357.0	</			

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 300. PSIA PE 0.05 PSIA

COMPONENT	TREF FORMULA DEG K	DENSITY GM/CC	HEAT FORM (KCAL/FORM.WT.)	WT. O/O
298 H2O2		1.448	-44.84	72.
298 H5OH9		0.620	+7.74	28.

BULK DENSITY = 1.054 GM/CC
MIXTURE RATIO = 2.571 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
CHAMBER ENTROPY 336.07 EU/100GMS

	CHAMBER										THROAT									
	FROZEN EXPANSION																			
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.660	.285	.119	.050	169.9							
TEMP, DEG K	3053.2	2663.2	2317.5	2011.0	1860.0	1739.3	1498.5	1285.2	1096.6	930.6	785.0	657.9	2793.1							
ENTHALPY (-)	91.48	117.90	140.92	160.92	169.33	178.25	193.22	206.08	217.08	226.45	234.37	241.04	109.15							
CP	.6822	.6719	.6593	.6455	.6382	.6296	.6124	.5930	.5739	.5540	.5342	.5136	.6757							
IMPUL OPT		151.61	207.39	245.79	260.25	274.75	297.50	315.75	330.56	342.66	352.58	360.71	123.98							
IMPUL VAC		232.92	259.11	283.66	293.68	304.06	320.82	334.59	345.91	355.23	362.88	369.15	228.26							
EPSILON		1.054	1.600	2.797	3.707	5.165	9.809	18.918	36.802	71.909	140.716	275.103	1.000							
	SHIFTING EXPANSION																			
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	173.5							
TEMP, DEG K	3053.2	2785.2	2530.6	2284.3	2171.2	2053.3	1945.9	1845.5	1751.5	1663.4	1581.1	1504.1	2882.6							
ENTHALPY (-)	91.48	118.36	142.63	164.49	173.91	184.07	201.88	218.38	233.68	247.88	261.09	273.40	108.71							
X BAR	5.354	5.304	5.266	5.241	5.233	5.218	5.094	4.976	4.865	4.761	4.663	4.572	5.321							
N	5.354	5.304	5.266	5.241	5.233	5.228	5.225	5.223	5.222	5.221	5.220	5.220	5.321							
CP	1.2620	1.1416	1.0143	.8950	.8431	.79482	.750863	.71333	.68233	.65128	.62667	.60396	1.1871							
IMPUL OPT		152.91	210.95	252.03	267.79	283.81	309.91	332.26	351.72	368.86	384.12	397.82	122.43							
IMPUL VAC		236.43	265.57	293.10	304.47	316.45	337.56	356.16	372.66	387.42	400.72	412.77	230.75							
EPSILON		1.065	1.662	2.982	3.999	5.657	11.439	23.593	49.360	104.401	222.777	478.825	1.000							
	COMPOSITION SHIFTING (MOL/100 GM)																			
132.60 H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
114.76 B#H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 B#H#C	.4033	.3241	.2429	.1638	.1296	.0957	.0582	.0332	.0178	.0091	.0044	.0021	.3538							
-135.32 B#H#O2	1.2847	1.3430	1.3857	1.4128	1.4210	1.4213	1.3470	1.2668	1.1760	1.0721	.9555	.8285	1.3231							
66.00 H#H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
-45.00 B#H2#O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
18.00 B#H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
-738.60 B#H3#O3	.0004	.0002	.0002	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0000	.0000	.0003							
5.74 B#C	.0516	.0280	.0126	.0043	.0023	.0011	.0005	.0002	.0001	.0000	.0000	.0000	.0358							
-34.00 B#O2	.0525	.0356	.0211	.0105	.0070	.0043	.0030	.0020	.0013	.0008	.0005	.0003	.0417							
119.30 B2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
-111.60 B2#O2	.0382	.0304	.0220	.0136	.0101	.0067	.0030	.0012	.0004	.0001	.0000	.0000	.0334							
-210.10 B2#O3	.1736	.2122	.2549	.2988	.3180	.3303	.2690	.2082	.1528	.1064	.0703	.0442	.1973							
-541.69 B3#H3#O6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
52.10 H	.1550	.1019	.0592	.0288	.0190	.0117	.0086	.0062	.0043	.0029	.0019	.0012	.1205							
9.33 H#B	.0103	.0044	.0016	.0005	.0002	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0062							
.00 H2	2.6891	2.8027	2.9128	3.0137	3.0555	3.0956	3.1379	3.1656	3.1824	3.1970	3.1970	3.1996	2.7608							
-57.80 H2#O	.4949	.4214	.3535	.2944	.2706	.2510	.2661	.2924	.3296	.3772	.4332	.4956	.4481							
59.56 O	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002							
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
-305.34 B2#O3/C	.0000	.0000	.0000	.0000	.0000	.0098	.1316	.2475	.3572	.4605	.5575	.6484	.0000							

SYSTEM LIQUID BIPROPELLANT												PC 300. PSIA				PF 0.05 PSIA			
COMPONENT												IREF FORMULA				WT. G/O			
DEG K												DENSITY				HEAT FORM			
												GN/CC				(KCAL/POUN.WT.)			
												298 H2+O2				-44.84			
												298 O2+H2				+7.74			
												FROZEN EXPANSION				72.			
												C STAR = 5923.7 FT/SEC				28.			
												C STAR = 6024.2 FT/SEC							
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP	CAL/	I OPT	DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC				
			DEG K	KCAL/100GM	GM DEG			/P		LVL	10000	50000	LVL						
	1.000	300.000	303.2	-91.48	.682														
1.000	1.766	169.911	279.1	-104.15	.676	124.0	104.3	.614	219.2	222.0	227.2	228.3	1.191	1.240					
2.000	8.662	36.635	218.0	-149.90	.654	225.9	44.1	1.272	251.3	256.9	267.8	270.0	1.165	1.406					
3.000	15.059	19.865	197.2	-163.10	.644	249.6	36.7	1.484	259.2	267.3	281.1	286.3	1.408	1.655					
4.000	22.759	13.181	184.6	-171.46	.636	263.8	32.4	2.458	270.9										
5.000	31.263	9.658	175.2	-177.42	.630	273.4	29.7	3.071											
6.000	40.132	7.475	167.9	-182.01	.626	280.6	27.7	3.704											
7.000	49.780	6.026	162.0	-185.69	.622	286.3	26.2	4.345											
8.000	59.658	5.029	157.0	-188.76	.618	290.9	25.0	4.988											
9.000	69.547	4.314	152.7	-191.37	.615	294.8	24.0	5.563											
10.000	79.591	3.769	149.1	-193.63	.612	298.1	23.2	6.145											
11.000	89.760	3.298	145.9	-195.63	.609	301.0	22.4	6.801											
12.000	100.000	2.903	142.9	-197.41	.607	303.4	21.8	7.456											
13.000	110.548	2.614	140.3	-199.01	.604	305.9	21.2	8.105											
14.000	120.558	2.370	137.9	-200.46	.602	307.9	20.7	8.742											
15.000	130.551	2.165	135.7	-201.79	.600	309.8	20.3	9.364											
16.000	140.517	1.992	133.6	-202.91	.598	311.5	19.9	9.987											
17.000	150.443	1.847	131.7	-203.83	.596	313.1	19.5	10.549											
18.000	160.327	1.722	130.3	-205.18	.594	314.5	19.1	11.112											
19.000	170.171	1.613	128.8	-206.16	.593	315.9	18.8	11.663											
20.000	180.000	1.503	127.4	-207.07	.591	317.1	18.5	12.215											
21.000	190.000	1.402	126.3	-207.99	.589	318.1	18.2	12.768											
22.000	200.000	1.313	125.0	-208.74	.588	319.4	18.0	13.321											
23.000	210.000	1.242	123.7	-209.51	.587	320.4	17.7	13.874											
24.000	220.000	1.172	122.4	-210.23	.586	321.4	17.5	14.427											
25.000	230.000	1.109	121.3	-210.92	.585	322.3	17.3	14.980											
26.000	240.000	1.053	120.1	-211.57	.584	323.2	17.1	15.533											
27.000	250.000	1.002	119.1	-212.19	.583	324.1	16.9	16.086											
28.000	260.000	.955	117.0	-212.79	.582	324.9	16.7	16.639											
29.000	270.000	.913	116.2	-213.36	.581	325.6	16.5	17.192											
30.000	280.000	.874	115.1	-213.90	.580	326.3	16.3	17.745											
31.000	290.000	.838	114.2	-214.42	.579	327.0	16.2	18.298											
32.000	300.000	.806	113.4	-214.92	.578	327.7	16.0	18.851											
33.000	310.000	.775	112.5	-215.41	.577	328.3	15.9	19.404											
34.000	320.000	.746	111.7	-215.87	.576	329.0	15.7	19.957											
35.000	330.000	.722	110.9	-216.32	.575	329.6	15.6	20.510											
36.000	340.000	.698	110.2	-216.75	.575	330.1	15.5	21.063											
37.000	350.000	.675	109.5	-217.17	.574	330.7	15.3	21.616											
38.000	360.000	.651	108.8	-217.57	.573	331.2	15.2	22.169											
39.000	370.000	.628	108.1	-217.96	.572	331.7	15.1	22.722											
40.000	380.000	.607	107.4	-218.34	.571	332.2	15.0	23.275											
41.000	390.000	.587	106.8	-218.75	.571	332.7	14.9	23.828											
42.000	400.000	.568	106.2	-219.08	.570	333.2	14.8	24.381											
43.000	410.000	.550	105.6	-219.40	.569	333.6	14.7	24.934											
44.000	420.000	.534	105.0	-219.74	.568	334.0	14.6	25.487											
45.000	430.000	.518	104.4	-220.06	.568	334.5	14.5	26.040											
46.000	440.000	.503	103.8	-220.38	.567	334.9	14.4	26.593											
47.000	450.000	.485	103.3	-220.69	.567	335.3	14.3	27.146											
48.000	460.000	.475	102.8	-221.00	.566	335.7	14.2	27.699											
49.000	470.000	.462	102.3	-221.28	.565	336.0	14.1	28.252											
50.000	480.000	.450	101.7	-221.57	.565	336.4	14.0	28.805											
51.000	490.000	.439	101.2	-221.85	.564	336.7	13.9	29.358											
52.000	500.000	.429	100.7	-222.13	.563	337.0	13.8	29.911											
53.000	510.000	.419	100.2	-222.41	.562	337.3	13.7	30.464											
54.000	520.000	.410	99.7	-222.69	.561	337.6	13.6	31.017											
55.000	530.000	.401	99.2	-222.97	.560	337.9	13.5	31.570											
56.000	540.000	.392	98.7	-223.25	.559	338.2	13.4	32.123											
57.000	550.000	.383	98.2	-223.53	.558	338.5	13.3	32.676											
58.000	560.000	.374	97.7	-223.81	.557	338.8	13.2	33.229											
59.000	570.000	.365	97.2	-224.09	.556	339.1	13.1	33.782											
60.000	580.000	.356	96.7	-224.37	.555	339.4	13.0	34.335											

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 300. PSIA PE 0.05 PSIA

COMPONENT	TREF FORMULA DEG K	DENSITY GM/CC	HEAT FORM (KCAL/FORM.WT.)	WT. O/O
298 H2*O2		1.448	-44.84	76.
298 B5*H9		0.620	+7.74	24.

PULK DENSITY = 1.097 GM/CC
MIXTURE RATIO = 3.167 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 329.52 EU/100GMS

CHAMBER THROAT

	FROZEN EXPANSION												
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	170.2
TEMP, DEG K	3201.0	2801.2	2445.9	2129.9	1994.6	1848.9	1599.0	1376.8	1179.4	1004.8	850.8	715.8	2935.0
ENTHALPY (-)	97.24	123.57	146.60	166.67	175.14	184.13	199.25	212.31	223.52	233.10	241.24	248.11	114.80
CP	.6637	.6534	.6422	.6285	.6216	.6133	.5966	.5776	.5581	.5384	.5185	.4983	.6572
IMPUL OPT		151.35	207.21	245.77	260.31	274.93	297.90	316.39	331.45	343.79	353.94	362.28	123.60
IMPUL VAC		232.67	259.08	283.85	293.98	304.48	321.49	335.51	347.08	356.63	364.50	370.96	227.94
EPSILON		1.056	1.607	2.416	3.738	5.215	9.936	19.275	37.522	73.556	144.402	283.273	1.000

	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	173.8
TEMP, DEG K	3201.0	2932.3	2675.1	2423.2	2306.0	2172.6	1924.7	1787.0	1696.4	1613.1	1536.4	1465.0	3030.7
ENTHALPY (-)	97.24	124.01	148.22	170.04	179.45	189.59	206.95	222.44	236.75	250.04	262.42	273.97	114.35
X BAR	5.082	5.021	4.771	4.934	4.921	4.910	4.898	4.811	4.700	4.596	4.498	4.407	5.043
N	5.082	5.021	4.971	4.934	4.921	4.910	4.898	4.896	4.895	4.894	4.894	4.894	5.043
CP	1.3636	1.2153	1.0573	.9027	.8356	.7694	.6771	4.4188	4.2990	4.1629	3.9955	3.7753	1.2726
IMPUL OPT		152.61	210.60	251.66	267.42	283.44	308.94	330.02	348.38	364.59	379.07	392.10	122.00
IMPUL VAC		236.02	265.18	292.73	304.11	315.37	335.32	352.54	368.16	382.17	394.83	406.33	230.30
EPSILON		1.065	1.664	2.987	4.006	5.648	10.931	22.273	46.700	99.039	211.946	456.917	1.000

	COMPOSITION SHIFTING (MOL/100 GM)												
132.60 H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
114.76 H*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 H*H*O	.2019	.1515	.1055	.0658	.0503	.0353	.0155	.0076	.0040	.0021	.0011	.0005	.1699
-135.32 H*H*O2	1.3459	1.4229	1.4906	1.5470	1.5693	1.5915	1.6247	1.5212	1.3631	1.2025	1.0419	.8843	1.3953
66.00 H*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.00 H*H2*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 H*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 H*H3*O3	.0006	.0004	.0003	.0003	.0003	.0003	.0004	.0004	.0003	.0002	.0002	.0001	.0005
5.74 H*O	.0422	.0231	.0106	.0037	.0020	.0009	.0001	.0000	.0000	.0000	.0000	.0000	.0295
-84.00 H*O2	.0918	.0682	.0450	.0252	.0178	.0111	.0036	.0018	.0011	.0006	.0004	.0002	.0771
199.30 H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.60 H2*O2	.0111	.0076	.0046	.0024	.0016	.0010	.0003	.0001	.0000	.0000	.0000	.0000	.0088
-210.10 H2*O3	.0975	.1091	.1192	.1264	.1283	.1293	.1272	.0995	.0703	.0482	.0322	.0207	.1049
-541.69 H3*H3*O6	.0000	.0000	.0000	.0000	.0000	.0000	.0001	.0001	.0001	.0001	.0001	.0001	.0000
52.10 H	.2008	.1421	.0897	.0480	.0332	.0202	.0062	.0032	.0022	.0015	.0010	.0006	.1634
9.33 H*O	.0388	.0207	.0096	.0036	.0021	.0010	.0002	.0001	.0000	.0000	.0000	.0000	.0265
.00 H2	2.0586	2.1286	2.1921	2.2451	2.2652	2.2839	2.3076	2.3163	2.3202	2.3223	2.3234	2.3240	2.1030
-57.80 H2*O	.9907	.9460	.9035	.8661	.8359	.8123	.8607	.9385	1.0181	1.0981	1.1769	.9626	
59.56 O	.0022	.0008	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0012
.00 O2	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
-305.34 H2*O3*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0845	.1951	.2987	.3958	.4864	.0000

SYSTEM LIQUID BIPHOPPELLANT

PC 300. PSIA

PF 0.05 PSIA

		COMPONENT		TREE FORMULA		DENSITY		HEAT FORM		WT. D/F			
				DIG. K		GM/CC		(KCAL/FORM.WT.)					

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Ford Motor Company,
AERONUTRONIC DIVISION

$N_2F_4 - B_5H_9$ SYSTEM

PRESSURE PROFILE DATA					
SYSTEM LIQUID BIPROPELLANT	PC 1000 PSIA				
COMPONENT	TREF FORMULA	DENSITY	HEAT FORM	WT. 0/0	
LEG K		GM/CC	(KCAL/FORM.WT.)		
198 N2+H4		1.500	-2.0	80.	
298 H5+H9		0.620	+7.74	20.	

BULK DENSITY = 1.168 GM/CC
MIXTURE RATIO = 4.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA													
CHAMBER ENTROPY 269.44 EU/100GMS													
CHAMBER	THROAT												
FROZEN EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	546.1
TEMP, DEG K	4202.9	3420.9	2775.2	2242.8	1804.4	1585.9	1443.7	1147.9	906.6	711.3	554.3	429.3	3672.5
ENTHALPY (-)	-91	31.39	57.65	78.91	96.06	104.43	109.82	120.79	129.49	136.34	141.70	145.87	21.05
CP	.4160	.4098	.4032	.3951	.3862	.3808	.3760	.3657	.3554	.3458	.3369	.3294	.4121
IMPUL OPT	167.64	225.71	265.52	290.45	302.73	310.37	325.39	336.82	345.55	352.23	357.34	358.23	138.23
IMPUL VAC	249.60	275.09	297.70	315.40	323.77	329.05	339.56	347.63	353.82	358.55	362.16	364.94	
EPSILON	1.054	1.595	2.773	5.084	7.327	9.561	12.213	15.909	19.055	21.878	24.696	27.000	
SHIFTING EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	546.8
TEMP, DEG K	4202.9	3420.9	2775.2	2242.8	1804.4	1585.9	1443.7	1147.9	906.6	711.3	554.3	429.3	3672.5
ENTHALPY (-)	-91	32.24	60.76	85.46	107.05	118.43	126.13	143.13	158.38	172.09	184.43	195.68	20.24
X BAR	4.646	4.547	4.450	4.353	4.254	4.197	4.156	4.064	3.978	3.902	3.839	3.737	4.584
N	4.646	4.547	4.450	4.353	4.254	4.197	4.156	4.064	3.978	3.902	3.839	3.802	4.584
CP	.9030	.8781	.8512	1.0141	1.1470	1.2165	1.2531	1.2925	1.3416	1.3904	1.4392	1.4880	
IMPUL OPT	169.82	221.63	274.11	306.47	322.22	332.45	353.99	372.26	387.95	401.54	413.55	425.66	135.66
IMPUL VAC	255.20	285.63	313.81	337.68	349.82	357.99	375.45	390.59	403.79	415.26	425.98	438.85	
EPSILON	1.070	1.700	3.139	6.149	9.343	12.743	16.887	21.724	27.258	33.543	40.683	48.683	1.000
COMPOSITION SHIFTING (MOL/100 GM)													
132.60 F	.0007	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
-45.47 F+F	1.3972	1.3941	1.3695	1.3209	1.2540	1.2102	1.1777	1.0991	1.0230	.9533	.8947	.7933	1.3974
-133.84 F+F2	.1391	.1185	.0990	.0791	.0598	.0495	.0428	.0292	.0189	.0114	.0062	.0044	.1261
-270.00 F+F2	.0458	.0702	.1144	.1830	.2692	.3243	.3625	.4547	.5411	.6182	.6821	.7199	.0591
114.76 F+F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
66.00 F+F2	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
18.00 F+F3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
199.30 B2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-124.20 B3+F6+N3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.0302	.0103	.0029	.0007	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0158
-64.50 F+F	1.2334	1.2246	1.1627	1.0477	.8951	.7974	.7256	.5549	.3923	.2456	.1230	.1147	1.2338
56.60 F+F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.4439	.2546	.1788	.1032	.0589	.0424	.0335	.0186	.0098	.0046	.0017	.0014	.3483
79.20 F+N	.0006	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
.00 F2	.5855	.6649	.7534	.8492	.9477	1.0048	1.0451	1.1380	1.2236	1.2996	1.3623	1.3666	.6334
40.30 F2+N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0008	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
.00 N2	.7684	.7689	.7691	.7691	.7691	.7691	.7691	.7691	.7691	.7691	.7691	.7691	.7688
-60.30 B+N/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

SYSTEM LIQUID BIPROPELLANT										PC 1000, PSIA									
COMPONENT										DENSITY HEAT ENTH									
LEG K										GM/CC (KCAL/FORM.WT.)									
198 H2+FN										J/SEC -2.0									
298 H2+FN										0.62C +7.74									
FROZEN EXPANSION																			
C STAR = 6288.8 FT/SEC																			
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC					
			DEG K	KCAL/100GM	GP DEG		/P	/P	LVL	10000	50000		LVL	LVL					
1.000	1.000	1000.000	202.2	-8.1	90.1														
1.001	546.073	3672.5	-21.05	-412	138.2	106.7	1.195	242.1	242.9	244.6	244.9	1.239	1.254						
2.000	10.185	98.182	2523.9	-67.75	400	245.1	40.5	411	279.5	281.3	283.9	1.431	1.502						
3.000	18.100	55.282	2178.6	-81.45	394	267.7	32.6	491	291.7	294.3	299.4	1.493	1.537						
4.000	28.594	34.972	1963.7	-89.86	390	281.1	28.0	800	297.3	300.9	307.7	1.551	1.582						
5.000	38.959	25.468	1814.9	-95.65	388	289.8	25.1	980	300.8	304.9	313.3	1.598	1.612						
6.000	51.620	19.600	1701.6	-100.01	384	296.3	23.1	1177	302.1	307.3	317.8	1.646	1.659						
7.000	63.772	15.681	1611.6	-103.45	381	301.3	21.5	1370	302.7	308.7	320.5	1.694	1.708						
8.000	77.393	12.921	1537.5	-106.27	379	305.4	20.2	1565	303.5	322.9	325.8	1.740							
9.000	91.761	10.898	1474.8	-108.64	377	308.7	19.2	1761	304.8	324.9	327.9	1.786							
10.000	106.833	9.300	1420.9	-110.67	375	311.9	18.3	1957		326.5	329.9	1.832							
11.000	122.959	8.133	1373.7	-112.44	374	314.0	17.6	2160		327.9	331.4	1.877							
12.000	139.758	7.155	1331.9	-114.00	372	316.2	16.9	2364		329.1	333.1	1.923							
13.000	157.087	6.366	1294.6	-115.30	371	318.1	16.3	2567		330.1	334.4	1.972							
14.000	174.806	5.721	1260.9	-116.48	370	319.8	15.8	2768		330.9	335.8	2.018							
15.000	192.787	5.181	1230.3	-117.57	369	321.3	15.4	2964		331.6	336.7	2.065							
16.000	210.919	4.741	1202.3	-118.60	368	322.7	15.0	3155		332.3	337.7	2.112							
17.000	229.113	4.365	1176.5	-119.74	367	324.0	14.6	3341		332.9	338.6	2.159							
18.000	247.358	4.044	1152.7	-120.67	366	325.2	14.2	3521		333.6	339.4	2.205							
19.000	265.781	3.737	1130.5	-121.41	365	326.2	13.9	3694		334.3	340.2	2.251							
20.000	284.401	3.461	1109.9	-122.18	364	327.2	13.6	3863		334.9	341.0	2.298							
21.000	310.698	3.219	1090.5	-122.88	363	328.2	13.3	4024		335.4	341.5	2.345							
22.000	332.902	3.008	1072.4	-123.54	363	329.0	13.1	4176		335.7	342.1	2.391							
23.000	355.452	2.811	1055.1	-124.16	362	329.9	12.8	4321		335.9	342.7	2.438							
24.000	378.283	2.644	1039.2	-124.75	361	330.6	12.6	4464		335.1	343.3	2.485							
25.000	401.310	2.492	1024.9	-125.30	361	331.4	12.4	4607		335.3	343.8	2.532							
26.000	424.533	2.356	1009.5	-125.82	360	332.0	12.2	4748		335.4	344.2	2.579							
27.000	447.936	2.233	995.7	-126.31	359	332.7	12.0	4889		335.5	344.7	2.626							
28.000	471.489	2.124	982.6	-126.78	359	333.3	11.8	5024		335.6	345.1	2.673							
29.000	494.945	2.022	970.2	-127.23	358	333.9	11.7	5157		335.7	345.6	2.720							
30.000	517.886	1.931	958.3	-127.65	358	334.4	11.5	5289		335.8	345.9	2.767							
31.000	541.115	1.849	946.9	-128.06	357	335.0	11.4	5421		335.9	346.3	2.814							
32.000	564.710	1.772	936.0	-128.45	357	335.5	11.2	5552		335.9	346.7	2.861							
33.000	588.712	1.703	926.5	-128.82	356	336.0	11.1	5684		336.0	347.0	2.908							
34.000	613.229	1.639	918.4	-129.18	356	336.4	10.9	5819		336.1	347.3	2.955							
35.000	638.387	1.579	910.8	-129.53	355	336.9	10.8	5954		336.2	347.7	2.999							
36.000	664.018	1.514	904.4	-129.86	355	337.3	10.7	6089		336.3	348.0	3.046							
37.000	689.822	1.454	898.7	-130.18	355	337.7	10.6	6224		336.4	348.3	3.093							
38.000	715.876	1.397	893.4	-130.49	354	338.1	10.4	6359		336.5	348.5	3.140							
39.000	743.001	1.345	888.4	-130.78	354	338.5	10.3	6494		336.6	348.8	3.187							
40.000	772.054	1.295	882.3	-131.07	353	338.8	10.2	6629		336.7	349.1	3.234							
41.000	801.032	1.248	876.5	-131.34	353	339.2	10.1	6764		336.8	349.3	3.281							
42.000	829.974	1.205	870.9	-131.61	353	339.6	10.0	6900		336.9	349.6	3.328							
43.000	858.858	1.168	865.6	-131.87	352	339.9	9.9	7035		337.0	349.8	3.375							
44.000	888.761	1.126	862.4	-132.12	352	340.2	9.8	7170		337.1	350.0	3.422							
45.000	918.682	1.089	859.5	-132.36	352	340.5	9.7	7305		337.2	350.2	3.469							
46.000	948.636	1.056	856.8	-132.60	351	340.8	9.6	7440		337.3	350.4	3.516							
47.000	977.570	1.023	854.3	-132.83	351	341.1	9.6	7575		337.4	350.7	3.563							
48.000	1007.486	992	852.0	-133.05	351	341.4	9.5	7710		337.5	350.9	3.610							
49.000	1037.416	964	849.8	-133.27	350	341.7	9.4	7845		337.6	351.1	3.657							
50.000	1067.351	936	847.9	-133.49	350	342.0	9.3	7980		337.7	351.2	3.704							
51.000	1097.290	908	846.2	-133.70	349	342.3	9.2	8115		337.8	351.4	3.751							
52.000	1127.234	880	844.6	-133.91	349	342.6	9.1	8250		337.9	351.6	3.798							
53.000	1157.182	852	843.1	-134.12	348	342.9	9.0	8385		338.0	351.8	3.845							
54.000	1187.134	824	841.6	-134.33	348	343.2	8.9	8520		338.1	352.0	3.892							
55.000	1217.090	796	840.1	-134.54	347	343.5	8.8	8655		338.2	352.2	3.939							
56.000	1247.049	768	838.6	-134.75	347	343.8	8.7	8790		338.3	352.4	3.986							
57.000	1277.011	740	837.1	-134.96	346	344.1	8.6	8925		338.4	352.6	4.033							

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 1000, PSIA
COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O

19R N2O4 1.500 -2.0 83.
29R B5H9 0.620 +7.74 11.

BULK DENSITY = 1.208 GM/CC
MIXTURE RATIO = 4.002 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 261.51 EU/100GMS

CHAMBER

THROAT

	FROZEN EXPANSION											
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100
TEMP, DEG K	4536.2	3689.4	2991.9	2417.9	1946.0	1711.1	1558.3	1240.4	980.9	770.4	601.2	466.1
ENTHALPY (-)	-49	32.72	59.70	81.54	99.15	107.77	114.30	124.59	133.55	140.62	146.15	150.46
CP	.3946	.3855	.3836	.3770	.3693	.3639	.3602	.3500	.3404	.3310	.3225	.3152
IMPUL OPT	169.57	228.82	267.13	294.42	306.88	314.62	329.87	341.48	350.37	357.17	362.57	367.30
IMPUL VAC	253.04	278.05	301.77	319.71	328.22	333.57	344.26	352.47	358.78	363.61	367.30	369.33
EPSILON	1.053	1.594	2.772	5.084	7.330	9.569	18.248	35.014	67.328	129.464	246.499	1.000

	SHIFTING EXPANSION											
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100
TEMP, DEG K	4536.2	4013.5	3544.9	3142.8	2813.5	2652.1	2547.7	2330.5	2147.9	1990.6	1851.0	1723.3
ENTHALPY (-)	-49	33.72	63.30	88.91	111.20	122.41	130.82	148.24	163.06	177.97	190.77	202.44
X BAR	4.427	4.327	4.235	4.145	4.051	3.995	3.955	3.861	3.770	3.684	3.605	3.532
N	4.427	4.327	4.235	4.145	4.051	3.995	3.955	3.861	3.770	3.684	3.605	3.532
CP	1.0003	.9004	.8654	.8201	1.0459	1.1373	1.2041	1.3492	1.4546	1.4941	1.4749	1.3672
IMPUL OPT	172.51	235.57	278.87	311.71	327.64	337.98	359.70	378.12	394.01	407.91	420.16	437.69
IMPUL VAC	259.54	290.67	319.25	343.32	355.60	361.75	381.33	396.64	410.11	422.05	432.69	452.92
EPSILON	1.072	1.704	3.138	6.169	9.327	12.637	26.631	57.273	125.036	276.000	613.982	1.000

	COMPOSITION SHIFTING (MOL/100 GM)											
132.60 B	.0008	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004
-45.47 B+F	1.1188	1.1240	1.1161	1.0867	1.0351	.9974	.9679	.8925	.8144	.7372	.6633	.5943
-133.84 B+F2	.1688	.1434	.1179	.0938	.0716	.0601	.0526	.0372	.0256	.0171	.0110	.0068
-270.00 B+F3	.0571	.0778	.1114	.1650	.2388	.2881	.3251	.4159	.5055	.5912	.6712	.7444
114.76 B+F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
66.00 B+F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 B+F3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
199.30 H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-124.20 B3+H2+N2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.1137	.0488	.0163	.0045	.0012	.0005	.0003	.0001	.0000	.0000	.0000	.0000
-64.50 F+B	1.4505	1.4987	1.4893	1.4179	1.2960	1.2095	1.1433	.9773	.8096	.6467	.4928	.3506
58.60 F+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.4641	.3480	.2397	.1542	.0944	.0711	.0580	.0357	.0219	.0132	.0077	.0042
79.20 H+N	.0008	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004
.00 H2	.2532	.2874	.3464	.4254	.5158	.5707	.6104	.7045	.7952	.8810	.9607	1.0336
40.30 H2+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 H3+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0022	.0007	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0011
.00 N2	.7984	.7975	.7978	.7979	.7979	.7980	.7980	.7980	.7980	.7980	.7980	.7972

SYSTEM LIQUID NITROGEN LIQUID										PC 1000, PSIA										HEAT FORM										WT. G/O									
COMPONENT										DENSITY										(KCAL/FORM.WT.)										H ₂									
LEG. K										1.000										-2.0										11.									
1000 B5000										0.000										0.000										11.									
FROZEN EXPANSION										C STAR = 6173.1 FT/SEC										C STAR = 6173.1 FT/SEC										C STAR = 6173.1 FT/SEC									
EPSILON										PL/P										P PSIA										TEMP									
1.000										1.000										1.000										1.000									
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1.000										1.00																													

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000, PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 158 N2O4 1.500 -2.0 85.
 298 B5H9 0.620 +7.74 15.

BULK DENSITY = 1.237 GM/CC
 MIXTURE RATIO = 5.667 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 255.53 EU/100GMS

CHAMBER														THROAT
FROZEN EXPANSION														
PRESSURE, PSIA	1000	398.1	156.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	568.0	
TEMP, DEG K	4728.7	3845.3	3118.6	2521.1	2030.2	1786.0	1627.2	1296.7	1026.7	807.5	631.0	490.0	4128.8	
ENTHALPY (-)	-20	33.20	60.33	82.31	100.03	108.71	114.28	125.67	134.71	141.86	147.46	151.82	22.53	
CP	.3806	.3757	.3707	.3647	.3573	.3526	.3449	.3396	.3302	.3211	.3130	.3058	.3774	
IMPLL OPT	170.47	229.48	267.92	295.30	307.81	315.59	330.91	342.60	351.55	358.41	363.56	364.62	140.62	
IMPLL VAC	253.78	279.67	302.67	320.69	329.24	334.63	345.38	353.66	360.03	364.91	368.64	369.05		
EPSILON	1.053	1.594	2.772	5.087	7.338	9.583	18.294	35.144	67.662	130.263	250.424	1.000		
SHIFTING EXPANSION														
PRESSURE, PSIA	1000	398.1	156.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	568.0	
TEMP, DEG K	4728.7	4240.2	3785.5	3367.9	2997.4	2812.9	2694.3	2450.7	2251.4	2084.1	1940.1	1813.2	4423.0	
ENTHALPY (-)	-20	34.38	64.59	90.95	113.89	125.88	133.96	151.69	167.52	181.77	194.70	206.48	21.58	
X BAR	4.272	4.162	4.068	3.985	3.903	3.853	3.816	3.727	3.638	3.553	3.472	3.395	4.203	
N	4.272	4.162	4.068	3.985	3.903	3.853	3.816	3.727	3.638	3.553	3.472	3.395	4.203	
CP	1.2147	1.0745	.9128	.8331	.8920	.9700	1.0382	1.2131	1.3737	1.5040	1.5824	1.6073	1.1355	
IMPLL OPT	173.44	237.43	281.60	315.05	331.19	341.63	363.51	381.98	397.88	411.77	424.01	437.68		
IMPLL VAC	261.41	293.56	322.80	347.15	359.48	367.65	385.73	400.52	413.97	425.91	435.59	254.40		
EPSILON	1.075	1.723	3.177	6.218	9.367	12.660	26.548	56.916	124.073	273.924	610.774	1.000		
COMPOSITION SHIFTING (MOL/100 GM)														
132.60 B	.0007	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	
-45.47 P=F	.9205	.9205	.9177	.9057	.8739	.8455	.8214	.7550	.6818	.6068	.5325	.4610	.9207	
-133.84 B=F2	.1921	.1688	.1410	.1110	.0831	.0691	.0602	.0424	.0292	.0196	.0129	.0083	.1783	
-270.00 B=F3	.0738	.0977	.1284	.1705	.2302	.2726	.3057	.3899	.4762	.5608	.6418	.7179	.0878	
114.76 B=H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
66.00 P=H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
18.00 B=H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
179.30 P2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-124.20 P3=H6=N3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
18.86 F	.2486	.1402	.0619	.0199	.0051	.0022	.0012	.0003	.0001	.0000	.0000	.0000	.1789	
-64.50 F=H	1.4939	1.5774	1.6219	1.6096	1.5329	1.4649	1.4087	1.2591	1.0998	.9401	.7850	.6374	1.5491	
58.60 F=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
52.10 F	.4028	.3195	.2438	.1744	.1163	.0903	.0750	.0480	.0307	.0196	.0124	.0077	.3506	
79.20 F=N	.0008	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	
.00 F2	.1198	.1199	.1256	.1765	.2439	.2909	.3267	.4150	.5033	.5886	.6698	.7460	.1184	
40.30 F2=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-11.04 F3=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
113.00 N	.0038	.0014	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0021	
.00 N2	.8149	.8163	.8169	.8171	.8172	.8172	.8172	.8172	.8172	.8172	.8172	.8172	.8159	

SYSTEM LIQUID BIPROPELLANT									
COMPONENT									
THEF FORMULA									
PC 1000-PS-4									
DENSITY									
HEAT FORM									
WT. 0/0									
150 N2H4									
200 55H9									
1.500									
-2.0									
85.									
15.									
FROZEN EXPANSION									
C STAR - 0.392-8 FT/SEC									
CP CAL / I OPT DELVAC DELVAC									
I SEA I AT I AT I VAC CP SEA CP VAC									
LVL 10000 50000 LVL									
EPSILON PC/P P PSIA TEMP ENTHALPY CP CAL / I OPT DELVAC DELVAC									
DEG K DEG K CAL/100GM GM DEG									
1.000 1.000 1000.000 4728.7									
2.000 1.0167 98.666 2835.8									
3.000 1.0166 55.230 2688.9									
4.000 28.587 34.481 2208.7									
5.000 18.025 25.490 2042.5									
6.000 50.941 18.830 1916.1									
7.000 63.643 15.813 1815.7									
8.000 77.163 12.954 1733.7									
9.000 91.422 10.931 1663.5									
10.000 106.446 9.196 1603.1									
11.000 122.461 8.166 1557.5									
12.000 139.140 7.187 1509.0									
13.000 156.142 6.396 1452.1									
14.000 173.931 5.749 1394.8									
15.000 191.777 5.216 1336.6									
16.000 209.772 4.767 1278.4									
17.000 227.829 4.389 1219.7									
18.000 245.865 4.067 1160.1									
19.000 263.771 3.783 1100.2									
20.000 281.676 3.486 1040.3									
21.000 300.451 3.242 979.7									
22.000 319.433 3.026 918.4									
23.000 338.757 2.835 856.4									
24.000 358.360 2.664 793.7									
25.000 378.179 2.511 730.3									
26.000 421.156 2.374 666.1									
27.000 444.235 2.254 601.8									
28.000 467.366 2.140 537.4									
29.000 490.563 2.039 472.9									
30.000 513.867 1.947 408.4									
31.000 538.285 1.863 343.9									
32.000 558.951 1.787 279.4									
33.000 582.425 1.717 214.9									
34.000 605.135 1.653 149.0									
35.000 627.715 1.593 84.6									
36.000 650.864 1.530 19.8									
37.000 680.837 1.469 1007.7									
38.000 708.215 1.412 988.0									
39.000 735.920 1.359 988.6									
40.000 763.930 1.309 978.4									
41.000 792.228 1.262 970.8									
42.000 820.774 1.218 962.3									
43.000 849.574 1.177 954.1									
44.000 878.549 1.138 946.1									
45.000 907.822 1.102 938.6									
46.000 937.152 1.067 930.9									
47.000 966.738 1.034 923.6									
48.000 996.421 1.004 916.5									
49.000 1026.220 974.909									
50.000 1056.117 902.9									
7.338 1086.044 1786.0									

SHIFTING EXPANSION																	
C STAR - 0.412-2 FT/SEC																	
CP CAL / I OPT DELVAC DELVAC																	
I SEA I AT I AT I VAC CP SEA CP VAC																	
LVL 10000 50000 LVL																	
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL / I	OPT	DELVAC	DELVAC	I	AT	I	AT	I	VAC	CP SEA	CP VAC	
			DEG K	KCAL/100GM	GM DEG												
1.000	1.000	1000.000	4728.7	1720	1.215												
2.000	1.001	507.964	3733.0	1211.8	1.136												
3.000	0.410	118.507	3673.3	-72.04		137.7	116.7	-206	251.4	252.3	254.1	254.4	1.238	1.423			
4.000	15.080	46.314	3402.3	-88.86		131.2	50.5	-425	945.5	297.4	101.2	301.7	1.410	1.480			
5.000	27.388	44.688	3230.7	-59.40		278.5	41.9	-832	312.2	314.0	319.4	320.5	1.514	1.559			
6.000	30.468	32.824	3108.0	-37.40		294.4	37.5	-838	319.6	323.3	330.5	331.9	1.555	1.615			
7.000	38.135	24.195	3014.4	-112.79		314.5	32.5	-838	324.5	329.1	336.9	338.9	1.579	1.644			
8.000	46.715	21.407	2941.1	-117.49		313.5	32.5	-1239	327.8	333.3	343.9	346.0	1.595	1.684			
9.000	55.677	17.661	2880.6	-121.42		320.0	30.9	-1443	329.7	334.3	348.4	350.9	1.604	1.707			
10.000	64.713	15.453	2829.7	-124.77		323.3	29.4	-1650	330.7	339.0	352.1	354.9	1.609	1.727			
11.000	74.035	13.496	2786.0	-127.97		329.7	28.6	-1852	331.1	339.3	355.2	358.3	1.611	1.744			
12.000	83.713	11.937	2749.0	-130.26		336.9	27.0	-2264	340.7	346.9	360.9	363.9	1.613	1.771			
13.000	93.518	10.491	2714.5	-132.56		336.9	26.4	-2409	340.9	346.2	360.9	363.9	1.613	1.782			
14.000	103.455	9.462	2684.5	-134.64		342.5	25.8	-2674	343.8	348.3	363.9	366.9	1.613	1.792			
15.000	113.942	8.776	2657.5	-136.56		346.3	25.4	-2944	346.3	350.9	366.9	369.9	1.613	1.804			
16.000	124.466	8.025	2633.0	-138.27		347.1	24.9	-3101	347.1	351.0	367.9	370.9	1.613	1.810			
17.000	135.442	7.383	2610.6	-139.87		349.1	24.5	-3316	349.1	351.0	367.9	373.4	1.618	1.825			
18.000	146.468	6.830	2590.0	-141.35		350.5	24.1	-3530	349.0	351.0	369.0	375.0	1.620	1.838			
19.000	157.463	6.351	2570.9	-142.73		352.6	23.8	-3744	350.5	351.0	370.0	376.4	1.622	1.852			
20.000	168.569	5.932	2553.3	-144.02		354.5	23.5	-3958	351.9	351.0	370.9	377.9	1.624	1.864			
21.000	179.640	5.565	2536.8	-145.23		355.7	23.2	-4165	353.9	351.0	371.8	378.9	1.626	1.876			
22.000	190.757	5.241	2521.4	-146.37		357.1	22.9	-4372	356.2	352.0	372.6	380.0	1.628	1.888			
23.000	201.842	4.954	2506.9	-147.44		358.4	22.7	-4578	357.3	353.1	373.3	381.1	1.629	1.894			
24.000	212.885	4.698	2493.3	-148.46		359.6	22.4	-4784	358.4	354.1	374.0	382.1	1.630	1.900			
25.000	223.787	4.468	2480.5	-149.43		360.8	22.2	-4972	359.5	354.1	374.5	383.0	1.631	1.904			
26.000	234.617	4.262	2468.3	-150.35		361.9	22.0	-5165	360.5	354.1	375.1	383.9	1.632	1.908			
27.000	245.347	4.076	2456.5	-151.23		363.0	21.8	-5354	361.5	354.1	375.6	384.4	1.633	1.912			
28.000	256.078	3.895	2445.0	-152.06		364.0	21.6	-5546	362.5	354.1	376.1	385.1	1.634	1.917			
29.000	266.722	3.716	2433.3	-152.87		365.0	21.4	-5737	363.5	354.1	376.5	385.5	1.635	1.920			
30.000	281.423	3.551	2425.3	-153.64		365.8	21.3	-5930	364.5	354.1	376.9	387.1	1.636	1.924			
31.000	294.226	3.399	2415.7	-154.38		366.7	21.1	-6220	365.4	354.1	377.2	387.9	1.637	1.928			
32.000	306.917	3.258	2406.5	-155.09		367.6	21.0	-6441	366.3	354.1	377.4	388.5	1.638	1.931			
33.000	319.487	3.119	2397.7	-155.77		368.4	20.8	-6664	367.2	354.1	377.6	389.1	1.639	1.934			
34.000	332.350	3.007	2388.3	-156.43		369.1	20.7	-6885	368.1	354.1	377.8	389.9	1.640	1.937			
35.000	345.381	2.895	2381.1	-157.07		369.9	20.6	-7106	369.0	354.1	378.3	390.5	1.641	1.940			
36.000	358.287	2.791	2373.1	-157.68		370.6	20.4	-7326	370.0	354.1	378.6	391.3	1.642	1.943			
37.000	371.214	2.684	2365.0	-158.27		371.3	20.3	-7545	370.9	354.1	378.8	391.9	1.643	1.946			
38.000	384.150	2.605	2358.5	-158.85		372.0	20.2	-7764	371.8	354.1	379.0	392.6	1.644	1.949			
39.000	397.093	2.518	2351.5	-159.40		372.6	20.1	-7980	372.6	354.1	379.1	392.7	1.645	1.951			
40.000	410.003	2.439	2344.7	-159.94		373.3	20.0	-8199	373.3	354.1	379.3	393.3	1.646	1.954			
41.000	422.958	2.365	2338.2	-160.47		373.9	19.9	-8409	373.9	354.1	379.4	393.8	1.647	1.956			
42.000	435.941	2.295	2331.5	-160.98		374.5	19.8	-8618	374.5	354.1	379.5	394.3	1.648	1.959			
43.000	448.580	2.229	2325.6	-161.47		375.0	19.7	-8831	375.0	354.1	379.7	394.7	1.649	1.962			
44.000	461.348	2.168	2319.1	-161.95		375.6	19.6	-9034	375.6	354.1	379.8	395.2	1.650	1.965			
45.000	474.058	2.109	2313.9	-162.42		376.1	19.5	-9245	376.1	354.1	379.9	395.6	1.651	1.968			
46.000	486.777	2.052	2308.7	-162.87		376.6	19.4	-9456	376.6	354.1	380.0	396.0	1.652	1.971			
47.000	499.277	2.003	2302.8	-163.31		377.2	19.3	-9650	377.2	354.1	380.1	396.5	1.653	1.974			
48.000	511.775	1.954	2297.4	-163.74		377.7	19.2	-9849	377.7	354.1	380.1	396.9	1.654	1.977			
49.000	524.192	1.908	2292.3	-164.17		378.1	19.2	-10046	378.1	354.1	380.2	397.3	1.655	1.979			
50.000	536.525	1.864	2287.2	-164.58		378.6	19.1	-10241	378.6	354.1	380.2	397.7	1.656	1.982			
51.000	548.770	1.821	2282.1	-164.98		379.0	19.0	-10437	379.0	354.1	380.3	398.1	1.657	1.985			
52.000	560.940	1.780	2276.9	-165.38		379.4	18.9	-10632	379.4	354.1	380.3	398.5	1.658	1.988			
53.000	573.040	1.740	2271.7	-165.78		379.7	18.8	-10825	379.7	354.1	380.4	398.9	1.659	1.991			
54.000	585.060	1.700	2266.5	-166.17		380.0	18.7	-11018	380.0	354.1	380.4	399.3	1.660	1.994			
55.000	597.000	1.660	2261.3	-166.56		380.3	18.6	-11210	380.3	354.1	380.5	399.7	1.661	1.997			
56.000	608.860	1.620	2256.1	-166.95		380.6	18.5	-11402	380.6	354.1	380.5	399.9	1.662	1.999			
57.000	620.640	1.580	2250.9	-167.34		380.9	18.4	-11594	380.9	354.1	380.6	400.1	1.663	2.001			
58.000	632.340	1.540	2245.7	-167.73		381.2	18.3	-11785	381.2	354.1	380.6	400.3	1.664	2.003			
59.000	643.960	1.500	2240.5	-168.12		381.5	18.2	-11976	381.5	354.1	380.7	400.5	1.665	2.005			
60.000	655.500	1.460	2235.3	-168.51		381.8	18.1	-12166	381.8	354.1	380.7	400.7	1.666	2.007			
61.000	666.960	1.420	2230.1	-168.90		382.1	18.0	-12356	382.1	354.1	380.8	400.9	1.667	2.009			
62.000	678.340	1.380	2224.9	-169.29		382.4	17.9	-12545	382.4	354.1	380.8	401.1	1.668	2.011			
63.000	689.640	1.340	2219.7	-169.68		382.7	17.8	-12734	382.7	354.1	380.9	401.3	1.669	2.013			
64.000	700.860	1.300	2214.5	-170.07		383.0	17.7	-12923	383.0	354.1	380.9	401.5	1.670	2.015			
65.000	712.000	1.260	2209.3	-170.46		383.3	17.6	-13112	383.3	354.1	381.0	401.7	1.671	2.017			
66.000	723.060	1.220	2204.1	-170.85		383.6	17.5	-13301	383.6	354.1	381.0	401.9	1.672	2.019			
67.000	734.040	1.180	2198.9	-171.24		383.9	17.4	-13490	383.9	354.1	381.1	402.1	1.673	2.021			
68.000	744.940	1.140	2193.7	-171.63		384.2	17.3	-13679	384.2	354.1	381.1	402.3	1.674	2.023			
69.000	755.760	1.100	2188.5	-172.02		384.5	17.2	-13868	384.5	354.1	381.2	402.5	1.675	2.025			
70.000	766.500	1.060	2183.3	-172.41		384.8	17.1	-14057	384.8	354.1	381.2	402.7	1.676	2.027			
71.000	777.160	1.020	2178.1	-172.80		385.1	17.0	-14246	385.1	354.1	381.3	402.9	1.677	2.029			
72.000	787.740	0.980	2172.9	-173.19		385.4	16.9	-14435	385.4	354.1	381.3	403.1	1.678	2.031			
73.000	798.240	0.940	2167.7	-173.58		385.7	16.8	-14624	385.7	354.1	381.4	403.3	1.679	2.033			
74.000	808.660	0.900	2162.5	-173.97		386.0	16.7	-14813	386.0	354.1	381.4	403.5	1.680	2.035			
75.000	819.000	0.860	2157.3	-174.36		386.3	16.6	-15002	386.3	354.1	381.5	403.7	1.681	2.037			
76.000	829.260	0.820	2152.1	-174.75		386.6	16.5	-15191	386.6	354.1	381.5	403.9	1.682	2.039			
77.000	839.440	0.780	2146.9	-175.14													

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 198 N2O4 1.500 -2.0 87.
 298 H5OH 0.620 +7.74 13.

BULK DENSITY = 1.266 GM/CC
 MIXTURE RATIO = 6.692 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 248.97 EU/100GMS

CHAMBER	THROAT													
	FROZEN EXPANSION													
PRESSURE, PSIA	1000	398.1	156.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	548.4	
TEMP, DEG K	4850.9	3942.9	3196.9	2584.3	2081.5	1831.5	1668.9	1330.9	1054.8	830.4	649.6	505.1	4238.7	
ENTHALPY (-)	.08	33.16	60.00	81.74	99.28	107.87	113.39	124.66	133.63	140.72	146.28	150.61	22.42	
CP	.3661	.3619	.3575	.3521	.3453	.3410	.3376	.3292	.3201	.3113	.3036	.2966	.3634	
IMPLL OPT		169.63	228.32	266.54	293.77	306.22	313.96	329.21	340.85	349.78	356.63	361.88	139.42	
IMPLL VAC		252.49	278.23	301.10	319.03	327.54	332.91	343.62	351.48	358.24	363.12	366.85	247.79	
EPSILON		1.053	1.594	2.772	5.088	7.341	9.588	18.317	35.217	67.869	130.802	251.778	1.000	
	SHIFTING EXPANSION													
PRESSURE, PSIA	1000	398.1	156.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	570.5	
TEMP, DEG K	4850.9	4402.0	4008.3	3646.9	3292.3	3083.8	2937.7	2628.6	2384.9	2190.1	2029.1	1891.5	4569.5	
ENTHALPY (-)	.08	34.43	64.76	91.65	115.46	128.00	136.43	154.79	171.00	185.47	198.51	210.36	21.53	
X BAR	4.123	4.000	3.888	3.791	3.711	3.672	3.645	3.576	3.500	3.421	3.343	3.268	4.047	
N	4.123	4.000	3.888	3.791	3.711	3.672	3.645	3.576	3.500	3.421	3.343	3.268	4.047	
CP	1.5045	1.4773	1.3457	1.1080	.8403	.7511	.7433	.8701	1.0727	1.2666	1.4229	1.5278	1.4970	
IMPLL OPT		172.87	237.20	282.24	316.83	333.59	344.41	366.87	385.60	401.59	415.48	427.71	136.60	
IMPLL VAC		260.92	294.00	324.59	350.17	362.94	371.29	389.02	404.31	417.72	429.59	440.20	253.63	
EPSILON		1.078	1.747	3.272	6.471	9.736	13.106	27.128	57.559	124.603	273.909	609.144	1.000	
	COMPOSITION SHIFTING (MOL/100 GM)													
132.60 B	.0005	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003	
-45.47 B*F	.7150	.6996	.6834	.6685	.6559	.6474	.6380	.5994	.5421	.4756	.4062	.3372	.7058	
-133.84 B*F2	.2112	.1920	.1682	.1402	.1088	.0897	.0767	.0513	.0339	.0222	.0144	.0091	.2001	
-270.00 B*F3	.1022	.1371	.1773	.2201	.2642	.2919	.3142	.3782	.4529	.5310	.6083	.6826	.1228	
114.76 B*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
66.00 B*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
18.00 B*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
199.30 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-124.20 F3*H6*N3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
18.86 F	.4553	.3245	.2089	.1124	.0433	.0199	.0104	.0021	.0004	.0001	.0000	.0000	.3739	
-64.50 F*H	1.4462	1.5262	1.5851	1.6238	1.6361	1.6234	1.6012	1.5069	1.3765	1.2323	1.0856	.9421	1.4974	
58.60 F*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
.02.10 F	.3018	.2393	.1698	.1502	.1169	.0987	.0860	.0590	.0392	.0258	.0169	.0109	.2621	
79.20 F*N	.0000	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	
.00 F2	.0517	.0432	.0386	.0390	.0495	.0650	.0825	.1431	.2182	.2970	.3748	.4494	.0461	
40.30 F2*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-11.04 F3*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
113.00 N	.0051	.0023	.0010	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0032	
.00 N2	.8335	.8351	.8359	.8362	.8364	.8364	.8364	.8364	.8364	.8364	.8364	.8364	.8364	

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/F3RM.WT.)
 198 N2*F4 1.500 -2.0 90.
 298 H5*H9 0.620 +7.74 10.

PULK DENSITY = 1.314 GM/CC
 MIXTURE RATIO = 9.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 238.07 EU/100GMS

CHAMBER	FROZEN EXPANSION										THROAT									
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	545.2							
TEMP, DEG K	4893.3	3970.1	3211.7	2594.5	2087.6	1836.1	1672.7	1333.5	1056.9	832.4	651.6	507.1	4264.8							
ENTHALPY (-)	.51	32.24	57.97	78.76	92.53	103.72	108.99	119.75	128.31	135.07	140.38	144.52	22.15							
CP	.3454	.3418	.3381	.3334	.3276	.3238	.3209	.3134	.3051	.2971	.2899	.2834	.3431							
IMPLL OPT		166.17	223.59	260.93	287.51	299.66	307.21	322.08	333.44	342.15	348.83	353.96	137.21							
IMPLL VAC		247.27	272.39	294.68	312.16	320.46	325.69	336.14	344.20	350.40	355.17	358.82	242.72							
EPSILON		1.053	1.591	2.764	5.071	7.314	9.551	18.244	35.084	67.643	130.454	251.311	1.000							
	SHIFTING EXPANSION																			
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	571.9							
TEMP, DEG K	4893.3	4473.0	4130.1	3824.9	3566.1	3425.4	3329.0	3110.3	2899.7	2679.9	2413.2	2124.6	4633.1							
ENTHALPY (-)	.51	33.57	62.93	69.21	112.89	125.62	134.33	153.61	171.55	187.67	202.15	214.87	21.05							
X BAR	3.926	3.793	3.669	3.554	3.448	3.391	3.351	3.264	3.187	3.123	3.083	3.055	3.844							
N	3.926	3.793	3.669	3.554	3.448	3.391	3.351	3.264	3.187	3.123	3.083	3.055	3.844							
CP	1.8655	2.0696	2.2022	2.2492	2.1882	2.1029	2.0197	1.7390	1.3486	.8767	.4998	.5479	1.9962							
IMPLL OPT		169.60	233.04	277.90	312.68	329.91	341.20	365.20	385.74	403.51	418.83	431.84	133.68							
IMPLL VAC		256.20	289.25	320.15	346.67	360.35	369.47	389.23	406.45	421.44	434.19	444.84	248.87							
EPSILON		1.080	1.761	3.333	6.720	10.282	14.035	29.971	64.980	141.125	303.527	645.050	1.000							
	COMPOSITION SHIFTING (MOL/100 GM)																			
132.60 F	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001							
-45.47 F*F	.4024	.3673	.3324	.2985	.2660	.2478	.2351	.2063	.1802	.1591	.1466	.1302	.3811							
-133.84 F*F2	.2124	.1899	.1643	.1380	.1129	.0992	.0899	.0695	.0517	.0361	.0219	.0109	.1992							
-270.00 F*F3	.1766	.2343	.2548	.3550	.4126	.4445	.4665	.5157	.5596	.5963	.6229	.6504	.2110							
114.76 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
66.00 F*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
18.00 F*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
179.30 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
-124.20 F3*H*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
18.86 F	.8544	.7184	.5523	.4761	.3696	.3119	.2724	.1847	.1075	.0447	.0077	.0005	.7707							
-64.50 F*H	1.2454	1.2926	1.3232	1.3454	1.3618	1.3695	1.3743	1.3839	1.3912	1.3961	1.3991	1.3573	1.2774							
58.60 F*H	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
.00 F2	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001							
52.10 F	.1505	.1150	.0894	.0704	.0561	.0493	.0450	.0362	.0291	.0232	.0180	.0126	.1276							
79.20 F*H	.0003	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002							
.00 F2	.0122	.0085	.0060	.0044	.0034	.0029	.0027	.0023	.0022	.0027	.0063	.0274	.0097							
40.30 F2*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
-11.04 F3*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
113.00 N	.0057	.0029	.0015	.0008	.0004	.0003	.0002	.0001	.0000	.0000	.0000	.0000	.0038							
.00 N2	.8622	.8637	.8645	.8649	.8650	.8651	.8652	.8652	.8652	.8652	.8652	.8653	.8632							

SYSTEM LIQUID BIPROPELLANT													
COMPONENT		TREF FORMULA		PC 1000, PSIA		DENSITY		HEAT FORM		WT. O/O			
DEG K		DEG K		G/CC		(KCAL/FORM.WT.)		-2.0		90.			
198 N2+H4		258 B5+H9		1.500		0.420		+7.74		10.			
FROZEN EXPANSION													
C STAR = 6225.8 FT/SEC													
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	T OPT	DEL VAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC
			DEG K	KCAL/100GM	GM DEG		/P	LVL	10000	50000		LVL	
1.000	1.000	1000.000	4893.3	-51.345									
2.000	1.024	545.238	4264.8	-22.15	343	137.2	105.5	194	239.9	240.7	247.4	1.240	1.254
3.000	10.247	97.900	2917.4	-47.96	336	242.9	39.9	409	276.8	278.6	282.1	1.431	1.462
4.000	18.151	54.571	2517.3	-81.34	333	265.2	32.2	585	288.8	291.4	296.4	1.492	1.537
5.000	28.720	34.819	2269.2	-89.56	330	278.4	27.6	793	294.4	297.9	304.7	1.521	1.581
6.000	39.089	25.583	2097.9	-55.19	328	287.0	24.8	970	297.6	301.9	310.2	1.538	1.611
7.000	51.150	19.335	1967.7	-49.45	326	293.4	22.8	1165	298.0	304.2	314.7	1.545	1.634
8.000	63.947	15.638	1864.4	-102.81	324	298.3	21.2	1356	298.6	305.6	317.2	1.548	1.651
9.000	77.571	12.491	1779.4	-105.56	323	302.3	20.0	1550	306.4	319.6	322.3	1.546	1.666
10.000	91.918	10.479	1707.8	-107.86	322	305.6	19.0	1743	306.7	321.6	324.6	1.547	1.677
11.000	106.544	9.349	1646.1	-109.84	320	308.4	18.1	1938		321.2	326.5	1.547	1.687
12.000	123.051	8.127	1592.2	-111.57	319	310.8	17.4	2139		320.3	329.3	1.546	1.696
13.000	139.758	7.153	1544.4	-113.09	318	313.0	16.7	2341		325.7	329.7	1.544	1.704
14.000	157.063	6.367	1501.8	-114.44	317	314.8	16.2	2547		326.7	331.0	1.541	1.711
15.000	174.768	5.724	1461.3	-115.66	316	316.5	15.7	2741		327.5	332.2	1.537	1.717
16.000	192.549	5.192	1424.4	-116.77	316	318.0	15.2	2935		328.3	333.3	1.532	1.722
17.000	210.431	4.748	1396.4	-117.78	315	319.4	14.8	3125		328.9	334.2	1.527	1.727
18.000	228.715	4.372	1367.0	-118.70	314	320.7	14.5	3309		329.5	335.1	1.521	1.732
19.000	246.751	4.052	1339.8	-119.55	314	321.8	14.1	3488		330.0	335.9	1.516	1.736
20.000	264.805	3.747	1314.5	-120.35	313	322.9	13.8	3668		330.5	336.7	1.510	1.740
21.000	282.015	3.452	1290.9	-121.08	312	323.9	13.5	3846		330.8	337.4	1.504	1.744
22.000	299.647	3.229	1268.8	-121.77	312	324.8	13.3	4015		331.1	338.1	1.499	1.747
23.000	317.680	3.015	1248.1	-122.42	311	325.7	13.0	4184		331.3	338.7	1.495	1.750
24.000	335.049	2.824	1228.6	-123.02	310	326.5	12.8	4352		331.5	339.2	1.490	1.753
25.000	352.641	2.655	1210.2	-123.59	310	327.2	12.6	4520		331.7	339.8	1.485	1.756
26.000	369.544	2.503	1192.8	-124.13	309	327.8	12.3	4691		331.9	340.3	1.480	1.759
27.000	385.847	2.367	1176.3	-124.64	309	328.6	12.1	4862		332.0	340.8	1.475	1.761
28.000	401.647	2.244	1160.6	-125.13	308	329.3	12.0	5030		332.1	341.2	1.470	1.763
29.000	416.951	2.133	1145.6	-125.59	308	329.9	11.8	5198		332.2	341.7	1.465	1.765
30.000	431.935	2.033	1131.4	-126.02	308	330.5	11.6	5366		332.3	342.1	1.460	1.768
31.000	446.647	1.942	1117.8	-126.44	307	331.0	11.5	5530		332.4	342.5	1.455	1.770
32.000	461.048	1.858	1104.8	-126.84	307	331.5	11.3	5698		332.5	342.8	1.450	1.772
33.000	475.048	1.781	1092.1	-127.22	306	332.0	11.2	5862		332.6	343.1	1.445	1.774
34.000	488.848	1.711	1080.4	-127.59	306	332.5	11.0	6029		332.7	343.5	1.440	1.775
35.000	502.448	1.649	1068.9	-127.94	305	333.0	10.9	6198		332.8	343.9	1.435	1.777
36.000	515.848	1.590	1057.8	-128.28	305	333.4	10.8	6365		332.9	344.2	1.430	1.779
37.000	529.047	1.536	1047.2	-128.60	305	333.8	10.6	6529		333.0	344.5	1.425	1.780
38.000	542.047	1.485	1036.9	-128.92	304	334.2	10.5	6691		333.1	344.8	1.420	1.782
39.000	554.841	1.439	1027.0	-129.22	304	334.6	10.4	6855		333.2	345.0	1.415	1.783
40.000	567.348	1.396	1017.4	-129.51	304	335.0	10.3	7019		333.3	345.3	1.410	1.785
41.000	579.544	1.356	1008.1	-129.79	303	335.4	10.2	7181		333.4	345.6	1.405	1.786
42.000	591.444	1.318	999.2	-130.06	303	335.7	10.1	7341		333.5	345.9	1.400	1.787
43.000	603.044	1.281	990.5	-130.33	303	336.1	10.0	7502		333.6	346.2	1.395	1.788
44.000	614.444	1.245	982.1	-130.58	303	336.4	9.9	7662		333.7	346.5	1.390	1.790
45.000	625.644	1.210	974.0	-130.83	302	336.7	9.8	7822		333.8	346.8	1.385	1.791
46.000	636.644	1.176	966.0	-131.07	302	337.0	9.7	7982		333.9	347.1	1.380	1.792
47.000	647.444	1.143	958.4	-131.30	302	337.3	9.6	8141		334.0	347.4	1.375	1.793
48.000	658.044	1.111	950.9	-131.52	301	337.6	9.6	8300		334.1	347.7	1.370	1.794
49.000	668.444	1.080	943.7	-131.74	301	337.9	9.5	8460		334.2	347.9	1.365	1.795
50.000	678.644	1.050	936.6	-131.95	301	338.2	9.4	8619		334.3	348.2	1.360	1.796
7.314	68.046	14.696	1836.1	-103.72	324	299.7	20.8	1.415	299.7	305.9	318.0	1.549	1.656

SH-IRTING EXPANSION													
C STAR = 6480.1 FT/SEC													
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	T OPT	DEL VAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC
			DEG K	KCAL/100GM	GM DEG		/P	LVL	10000	50000		LVL	
1.000	1.749	571.884	4633.1	-21.05	1.966	133.7	115.2	201	245.9	246.8	248.5	1.236	1.221
2.000	8.010	124.851	4059.3	-49.02	1.966	244.4	31.7	414	290.2	292.1	295.4	1.441	1.471
3.000	14.468	69.119	3871.8	-85.47	1.966	272.2	43.5	630	304.5	309.3	314.7	1.522	1.568
4.000	20.640	48.449	3755.9	-85.81	1.966	288.0	39.7	819	315.6	319.3	326.3	1.567	1.627
5.000	27.954	35.174	3671.0	-103.42	1.966	299.3	36.9	1033	321.1	325.6	334.5	1.594	1.669
6.000	36.940	26.588	3585.4	-109.34	1.966	307.7	35.1	1226	324.8	330.2	340.7	1.612	1.702
7.000	41.954	23.813	3552.0	-114.14	1.966	314.4	33.6	1412	327.3	333.6	345.7	1.628	1.728
8.000	49.845	20.054	3506.9	-118.24	1.966	320.0	32.4	1617	328.7	335.9	349.7	1.632	1.750
9.000	57.847	17.299	3468.2	-121.75	1.966	324.8	31.5	1819	329.5	337.6	353.1	1.636	1.769
10.000	65.745	15.201	3434.3	-124.82	1.966	328.9	30.6	2016	329.9	338.8	356.1	1.638	1.785
11.000	74.073	13.500	3404.1	-127.55	1.966	332.4	29.9	2217	330.4	340.4	358.6	1.640	1.799
12.000	82.563	12.112	3376.9	-130.00	1.966	335.6	29.3	2421	330.1	340.8	361.0	1.642	1.812
13.000	91.118	10.975	3352.3	-132.23	1.966	338.5	28.8	2622	330.4	341.2	363.3	1.644	1.824
14.000	99.760	10.030	3329.8	-134.26	1.966	341.1	28.3	2820	330.6	341.6	365.4	1.646	1.834
15.000	108.472	9.198	3309.0	-136.13	1.995	343.5	27.8	3027			366.2	1.671	
16.000	117.926	8.480	3289.8	-137.86	1.979	345.7	27.4	3236			367.6	1.673	
17.000	127.273	7.857	3271.9	-139.47	1.959	347.7	27.1	3445			368.9	1.678	
18.000	136.748	7.313	3255.1	-140.98	1.945	349.6	26.7	3655			370.1	1.681	
19.000	146.284	6.836	3239.4	-142.39	1.920	351.3	26.4	3865			371.2	1.678	
20.000	155.858	6.414	3224.5	-143.71	1.902	353.0	26.1	4073			372.2	1.671	
21.000	165.552	6.040	3210.5	-144.96	1.884	354.5	25.9	4281			373.1	1.664	
22.000	175.224	5.707	3197.2	-146.15	1.866	356.0	25.6	4487			373.9	1.656	
23.000	184.955	5.408	3184.5	-147.27	1.848	357.3	25.4	4690			374.7	1.648	
24.000	194.730	5.140	3172.5	-148.34	1.832	358.6	25.1	4892			375.4	1.638	
25.000	204.572	4.898	3161.0	-149.36	1.816	359.9	24.9	5090			376.1	1.628	
26.000	214.479	4.678	3150.9	-150.33	1.800	361.0	24.7	5286			376.7	1.618	
27.000	224.443	4.475	3141.2	-151.27	1.784	362.2	24.5	5479			377.3	1.608	
28.000	234.473	4.297	3132.9	-152.15	1.768	363.2	24.4	5670			377.9	1.598	
29.000	244.568	4.130	3119.4	-153.01	1.753	364.2	24.2	5857			378.4	1.588	
30.000	251.453	3.976	3110.0	-153.83	1.739	365.2	24.0	6043			378.9	1.578	
31.000	262.166	3.818	3101.2	-154.63	1.724	366.2	23.8	6238			379.4	1.568	
32.000	272.892	3.652	3092.2	-155.40	1.709	367.2	23.6	6430			380.0	1.558	
33.000	283.773	3.524	3083.8	-156.13	1.696	367.9	23.6	6689			380.1	1.545	
34.000	294.650	3.393	3075.6	-156.86	1.682	368.8	23.4	6905			380.4	1.532	
35.000	305.671	3.271	3067.6	-157.53	1.668	369.8	23.3	7122			380.8	1.520	
36.000	316.768	3.157	3059.9	-158.20	1.655	370.8	23.2	7337			381.0	1.508	
37.000	327.789	3.051	3052.5	-158.84	1.642	371.1	23.0	7554			381.3	1.494	
38.000	338.911	2.951	3045.2	-159.47	1.629	371.9	22.9	7769			381.6	1.480	
39.000	350.063	2.857	3038.1	-160.07	1.616	372.6	22.8	7984			381.8	1.466	
40.000	361.238	2.768	3031.2	-160.66	1.604	373.3	22.7	8198			382.0	1.453	
41.000	372.429	2.672	3024.5	-161.23	1.592	374.0	22.6	8412			382.2	1.440	
42.000	383.428	2.607	3017.9	-161.80	1.580	374.6	22.5	8625			382.4	1.427	
43.000	394.428	2.533	3011.5	-162.34	1.568	375.2	22.4	8837			382.5	1.414	
44.000	406.023	2.463	3005.3	-162.87	1.556	375.8	22.3	9047			382.7	1.401	
45.000	417.240	2.397	3000.0	-163.38	1.544	376.4	22.2	9256			382.8	1.388	
46.000	428.372	2.334	2993.2	-163.88	1.534	377.0	22.1	9464			383.0	1.375	
47.000	439.551	2.275	2987.4	-164.37	1.523	377.6	22.0	9671			383.1	1.362	
48.000	450.630	2.219	2981.7	-164.85	1.512	378.1	21.9	9876			383.2	1.349	
49.000	461.713	2.166	2976.1	-165.32	1.501	378.7	21.8	10077			383.3	1.336	
50.000	472.799	2.116	2970.6	-165.78	1.490	379.2	21.7	10277			383.4	1.323	
10.282	68.046	14.696	3425.4	-125.62	1.923	329.9	30.4	2071	329.9	339.1	356.8	1.630	1.789

PRESSURE PROFILE DATA
 SYSTEM LIQUID HIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEC K GM/CC (KCAL/FORM.WT.)
 158 A2F4 1.500 -2.0 8C.
 258 55H9 0.620 +7.74 2C.

BULK DENSITY = 1.168 GM/CC
 MIXTURE RATIO = 4.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 280.66 FU/100GMS

CHAMBER	THROAT											
	FROZEN EXPANSION											
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050
TEMP, DEG K	4002.2	3280.3	2680.6	2182.7	1980.2	1769.8	1427.7	1145.2	913.0	723.5	569.9	446.4
ENTHALPY (-)	-51	28.80	53.12	72.36	80.91	89.08	102.12	112.61	121.00	127.68	132.95	137.09
CP	.4145	.4045	.4020	.3946	.3907	.3858	.3760	.3663	.3565	.3474	.3390	.3320
IMPLL OPT	160.78	216.80	253.50	266.80	279.80	299.39	314.76	325.67	334.46	341.25	346.49	348.38
IMPLL VAC	244.28	267.41	288.74	297.17	305.69	318.91	329.18	337.15	343.32	348.09	351.77	351.93
EPSILON	1.038	1.501	2.495	3.229	4.375	7.872	14.358	26.365	48.554	89.472	164.742	1.000
	SHIFTING EXPANSION											
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050
TEMP, DEG K	4002.2	3560.8	3172.8	2841.9	2707.8	2569.6	2347.2	2161.1	2000.7	1856.9	1727.6	1589.2
ENTHALPY (-)	-51	29.67	56.31	79.60	89.50	100.12	113.36	134.71	149.49	162.91	175.12	186.23
X BAR	4.734	4.631	4.535	4.440	4.395	4.344	4.248	4.155	4.067	3.985	3.912	3.850
N	4.734	4.631	4.535	4.440	4.395	4.344	4.248	4.155	4.067	3.985	3.912	3.850
CP	1.0052	.9538	.9468	1.0162	1.0771	1.1561	1.3067	1.4139	1.4454	1.3849	1.2235	.9698
IMPLL OPT	163.11	223.11	264.66	280.45	296.47	322.11	343.49	361.72	377.51	391.33	403.49	133.36
IMPLL VAC	250.51	278.86	305.88	317.14	329.02	348.88	366.09	381.17	394.46	406.22	416.60	245.52
EPSILON	1.054	1.605	2.832	3.784	5.337	10.474	21.111	43.355	90.183	189.088	397.404	1.000
	COMPOSITION SHIFTING (MOL/100 GM)											
132.60 P	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.47 B*F	1.4510	1.4509	1.4349	1.3968	1.3714	1.3375	1.2648	1.1868	1.1087	1.0340	.9654	.9063
-133.84 P*F2	.0101	.0868	.0745	.0624	.0566	.0498	.0377	.0273	.0189	.0125	.0079	.0045
-270.00 B*F3	.0304	.0451	.0736	.1237	.1550	.1956	.2805	.3689	.4554	.5364	.6097	.6722
114.76 P*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
66.00 P*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 P*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
179.30 B2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-124.20 B3*H*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.0372	.0137	.0042	.0011	.0006	.0003	.0001	.0000	.0000	.0000	.0000	.0000
-64.50 F*H	1.2952	1.3030	1.2677	1.1825	1.1263	1.0521	.8947	.7283	.5638	.4081	.2663	.1446
58.60 F*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.5447	.3784	.2397	.1415	.1097	.0821	.0480	.0281	.0162	.0090	.0045	.0019
79.20 F*N	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.5045	.5839	.6711	.7627	.8067	.8576	.9533	1.0464	1.1347	1.2162	1.2893	1.3515
40.30 F2*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 H	.0007	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 A2	.7666	.7690	.7691	.7691	.7691	.7691	.7691	.7691	.7691	.7691	.7691	.7689

PRESSURE PROFILE DATA
 SYSTEM LIQUID PROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. 0/0
 DEC K GM/CC (KCAL/FORM.WT.)
 198 N2*F4 1.500 -2.0 83.
 298 H5*H9 0.620 +7.74 17.

BULK DENSITY = 1.208 GM/CC
 MIXTURE RATIO = 4.882 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 272.21 EU/100GMS

CHAMBER	FROZEN EXPANSION										THROAT		
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	163.2
TEMP, DEG K	4303.8	3524.5	2878.3	2343.1	2125.6	1899.8	1533.2	1230.6	981.8	778.4	613.7	481.0	3743.1
ENTHALPY (-)	-49	29.98	54.89	75.21	83.35	91.72	105.08	115.83	124.43	131.28	136.69	140.95	21.47
CP	.3935	.3483	.3826	.3762	.3728	.3686	.3599	.3502	.3411	.3323	.3244	.3175	.3899
IMPLL OPT	162.80	219.49	256.62	270.07	283.23	303.04	318.10	329.66	338.57	345.46	350.77	358.20	138.20
IMPLL VAC	247.33	270.69	292.27	300.80	309.42	322.80	333.21	341.29	347.55	352.39	356.13	363.95	243.95
EPSILON	1.038	1.500	2.493	3.227	4.372	7.870	14.363	26.391	48.631	89.677	165.226	1.000	

	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	169.9
TEMP, DEG K	4303.8	3865.3	3457.4	3091.2	2938.9	2780.8	2527.1	2320.2	2147.6	2000.5	1871.5	1756.0	4014.4
ENTHALPY (-)	-49	31.02	58.64	82.82	93.07	104.04	122.82	139.58	154.68	168.39	180.91	192.39	20.51
X BAR	4.516	4.413	4.320	4.232	4.191	4.143	4.051	3.959	3.870	3.784	3.702	3.626	4.448
N	4.516	4.413	4.320	4.232	4.191	4.143	4.051	3.959	3.870	3.784	3.702	3.626	4.448
CP	1.1534	1.0065	.9154	.9230	.9599	1.0239	1.1858	1.3635	1.5205	1.6311	1.6835	1.6626	1.0548
IMPLL OPT	165.56	226.80	269.20	285.29	301.55	327.52	349.07	367.41	383.29	397.25	409.63	423.07	249.36
IMPLL VAC	254.63	283.74	311.22	322.61	334.58	354.54	371.82	386.96	400.37	412.33	423.07	429.36	
EPSILON	1.054	1.609	2.833	3.779	5.316	10.382	20.862	42.797	89.176	188.005	399.920	1.000	

	COMPOSITION SHIFTING (MOL/100 GM)												
132.60 E	.0007	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
-45.47 E*F	1.1758	1.1806	1.1775	1.1578	1.1411	1.1164	1.0565	.9855	.9096	.8330	.7581	.6866	1.1795
-133.84 P*F2	.1282	.1103	.0921	.0752	.0678	.0597	.0457	.0339	.0244	.0171	.0117	.0078	.1167
-270.00 P*F3	.0408	.0543	.0759	.1126	.1367	.1694	.2433	.3262	.4116	.4955	.5757	.6512	.0490
114.76 P*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
66.00 P*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 P*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
139.30 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-124.20 H3*H6*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.1454	.0684	.0251	.0075	.0041	.0020	.0005	.0001	.0000	.0000	.0000	.0000	.0914
-64.50 F*H	1.4918	1.5591	1.5774	1.5385	1.5011	1.4457	1.3135	1.1599	.9988	.8383	.6832	.5362	1.5406
58.60 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.5352	.4204	.3042	.2022	.1635	.1273	.0793	.0498	.0316	.0201	.0126	.0077	.4619
79.20 F*H	.0004	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
.00 F2	.1953	.2211	.2702	.3406	.3787	.4245	.5146	.6061	.6958	.7818	.8631	.9390	.2096
40.30 F2*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 H	.0021	.0007	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0010
.00 H2	.7967	.7975	.7978	.7979	.7979	.7979	.7980	.7980	.7980	.7980	.7980	.7980	.7973

EPSILON	PC/F	P PSIA	TEMP	ENTHALPY	SHIFTING EXPANSION											
					CM CAL/	C STAR	I OPT	DELTA	DELTA	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC	
				DEG K	DEG	DEG	/SEC	/F	/F	LVL	10000	50000	LVL	LVL		
1.000	1.000	300.000	4303.8	-	1.153	-	-	-	-	-	-	-	-	-	-	-
1.000	1.765	149.943	3291.1	-20.31	1.055	135.1	114.2	-672	239.5	242.5	248.2	249.4	1.237	1.188		
2.000	3.581	35.884	3299.1	-69.12		146.6	48.9	1.392	275.0	281.2	283.1	295.9	1.364	1.465		
3.000	14.789	20.285	3059.4	-84.94		272.6	41.0	2.020	283.9	292.9	310.2	313.6	1.408	1.555		
4.000	24.120	13.372	2911.0	-64.98		272.6	36.5	2.491		297.1	320.1	324.7		1.610		
5.000	29.950	10.717	2807.4	-112.15			33.7	3.078			324.8			1.315		
6.000	38.317	7.829	2729.9	-157.48		308.8	31.7	4.053			331.4	338.5		1.679		
7.000	47.218	6.354	2608.4	-112.16			31.7	30.2	4.758		335.2	343.3		1.703		
8.000	56.280	5.130	2618.1	-115.89		318.2	29.1	5.450			338.0	347.3		1.722		
9.000	64.925	4.192	2517.5	-119.07		323.5	28.1	6.192			340.2			1.740		
10.000	74.141	3.404	2539.7	-121.85		326.9	27.3	6.746			342.0	353.5		1.753		
11.000	83.651	3.585	2508.0	-124.30		329.5	26.6	7.422			343.4	356.1		1.766		
12.000	93.975	3.172	2480.0	-126.50		332.4	26.0	8.144			344.5	358.4		1.777		
13.000	104.421	2.873	2453.9	-128.49		335.0	25.5	8.885			345.3	360.5		1.788		
14.000	114.950	2.612	2402.4	-130.34		337.8	25.0	9.640			346.0			1.799		
15.000	125.488	2.391	2411.9	-121.96		339.5	24.6	10.279			346.5	364.0		1.805		
16.000	135.970	2.206	2393.2	-133.49		341.4	24.2	10.985			346.9	365.6		1.813		
17.000	146.346	2.050	2375.9	-134.91		343.2	23.8	11.633			347.2	367.1		1.820		
18.000	156.518	1.907	2340.0	-136.73		345.0	23.5	12.340			347.5			1.828		
19.000	166.454	1.870	2365.2	-137.47		346.4	23.2	12.904			347.7	369.7		1.833		
20.000	176.516	1.700	2331.4	-138.63		347.9	23.0	13.516				370.9				
21.000	186.462	1.609	2318.4	-139.72		349.3	22.7	14.120				372.0				
22.000	197.478	1.515	2306.1	-140.76		350.5	22.5	14.835				373.0				
23.000	208.462	1.421	2286.8	-141.76		351.8	22.3	15.491				374.0				
24.000	219.376	1.355	2283.7	-142.68		352.9	22.0	16.269				375.0				
25.000	233.215	1.286	2273.3	-143.57		354.0	21.8	16.986				375.9				
26.000	249.121	1.224	2263.5	-144.41		355.0	21.7	17.701				376.7				
27.000	267.013	1.162	2244.2	-145.22		356.0	21.5	18.416				377.5				
28.000	289.053	1.115	2226.3	-146.00		357.0	21.3	19.122				378.3				
29.000	281.044	1.067	2236.7	-146.74		357.9	21.2	19.825				379.1				
30.000	293.020	1.024	2228.6	-147.45		358.8	21.0	20.524				379.8				
31.000	304.955	.984	2220.8	-148.16		359.6	20.9	21.216				380.5				
32.000	316.927	.946	2213.3	-148.87		360.4	20.7	21.909				381.2				
33.000	328.813	.912	2206.1	-149.44		361.2	20.6	22.578				381.8				
34.000	340.642	.881	2199.2	-150.05		361.9	20.5	23.240				382.4				
35.000	352.425	.851	2192.5	-150.64		362.6	20.4	23.909				383.0				
36.000	364.156	.824	2186.1	-151.22		363.2	20.3	24.568				383.6				
37.000	375.754	.799	2179.9	-151.77		364.0	20.1	25.205				384.1				
38.000	387.229	.775	2173.9	-152.31		364.6	20.0	25.840				384.6				
39.000	398.667	.753	2168.1	-152.83		365.2	19.9	26.466				385.1				
40.000	410.014	.732	2162.5	-153.34		365.8	19.8	27.085				385.6				
41.000	421.270	.711	2157.0	-153.87		366.4	19.7	27.697				386.1				
42.000	432.436	.694	2151.7	-154.31		367.0	19.6	28.292				386.6				
43.000	443.859	.676	2146.6	-154.77		367.5	19.5	28.908				387.1				
44.000	456.883	.657	2141.6	-155.23		368.1	19.4	29.620				387.5				
45.000	469.937	.639	2136.7	-155.67		368.6	19.3	30.326				388.0				
46.000	483.056	.621	2132.0	-156.10		369.1	19.3	31.045				388.5				
47.000	496.234	.605	2127.4	-156.52		369.6	19.2	31.759				388.8				
48.000	509.468	.589	2122.9	-156.93		370.1	19.1	32.473				389.2				
49.000	522.751	.573	2118.6	-157.33		370.6	19.0	33.182				389.5				
50.000	536.078	.558	2114.3	-157.72		371.0	19.0	33.902				390.0				
3.779	20.414	14.696	2938.9	-93.07	.960	285.3	37.3	2.540	285.3	296.5	318.3	322.6	1.415	1.600		

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 198 N2*F4 1.500 -2.0 85.
 298 B5*H9 0.620 +7.74 15.

FULK DENSITY = 1.237 GM/CC
 MIXTURE RATIO = 5.667 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 265.86 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	164.1
TEMP, DEG K	4461.2	3651.9	2981.9	2427.3	2202.1	1968.6	1589.4	1276.4	1019.1	808.7	638.0	500.6	3883.7
ENTHALPY (-)	-20	30.30	55.24	75.58	83.73	92.10	105.47	116.25	124.87	131.74	137.17	141.45	21.60
CP	.3750	.3746	.3694	.3635	.3604	.3567	.3486	.3394	.3306	.3220	.3145	.3079	.3759
IMPLL OPT	162.91	219.62	256.76	270.22	283.39	303.21	318.29	329.86	338.80	345.71	351.04	357.74	
IMPLL VAC	247.47	270.84	292.42	300.96	309.58	322.98	333.41	341.52	347.80	352.67	356.42	356.10	
EPSILON	1.038	1.500	2.493	3.226	4.372	7.875	14.379	26.440	48.755	89.972	165.945	1.000	
	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.673	.680	.285	.119	.050	171.0
TEMP, DEG K	4461.2	4060.4	3687.4	3375.3	3160.5	2981.4	2685.8	2446.6	2252.7	2091.6	1954.5	1834.9	4198.2
ENTHALPY (-)	-20	31.49	59.61	84.51	95.10	106.44	125.75	142.88	158.22	172.09	184.72	196.29	20.69
X BAR	4.363	4.250	4.150	4.066	4.029	3.988	3.908	3.824	3.738	3.654	3.573	3.496	4.288
N	4.363	4.250	4.150	4.066	4.029	3.988	3.908	3.824	3.738	3.654	3.573	3.496	4.288
CP	1.4383	1.2886	1.0778	.8916	.8530	.8587	.9743	1.1594	1.3532	1.5328	1.6727	1.7657	1.3503
IMPLL OPT	166.05	228.11	271.46	287.94	304.59	331.02	352.81	371.24	387.15	401.09	413.45	413.82	
IMPLL VAC	255.89	286.11	314.52	326.18	338.34	358.44	375.74	390.85	404.22	416.14	426.86	426.26	
EPSILON	1.059	1.631	2.891	3.854	5.408	10.485	20.928	42.728	88.761	186.848	397.430	1.000	
	COMPOSITION SHIFTING (MOL/100 GM)												
132.60 F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
-45.47 F*F	.9800	.9776	.9732	.9652	.9580	.9448	.9035	.8449	.7764	.7039	.6308	.5592	.9789
-133.84 F*F2	.1459	.1350	.1165	.0948	.0842	.0727	.0540	.0392	.0280	.0196	.0135	.0092	.1407
-270.00 F*F3	.0558	.0744	.0575	.1272	.1450	.1698	.2298	.3032	.3829	.4637	.5429	.6188	.0673
114.76 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
46.00 F*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 F*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
149.30 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-124.20 F3*H*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.3068	.1926	.0593	.0378	.0213	.0104	.0075	.0006	.0002	.0000	.0000	.0000	.2315
-64.50 F*H	1.5118	1.6054	1.6709	1.6946	1.6850	1.6589	1.5655	1.4353	1.2876	1.1344	.9821	.8347	1.5750
58.60 F*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.4441	.3615	.2649	.2151	.1841	.1511	.1002	.0654	.0428	.0282	.0186	.0122	.3909
79.20 F*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
40.30 F2*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0033	.0014	.0005	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0019
.00 N2	.8153	.8164	.8169	.8171	.8171	.8172	.8172	.8172	.8172	.8172	.8172	.8172	.8161

[illegible]

PRESSURE PROFILE DATA
 SYSTEM LIQUID PROPELLANT PC 300. PSIA
 COMPONENT TREE FORMULA DENSITY HEAT FORM WT. O/O
 DEC K GM/CC (KCAL/FORM.WT.)
 198 N2O4 1.500 -2.0 87.
 298 H5OH 0.620 +7.74 13.

PULK DENSITY = 1.266 GM/CC
 MIXTURE RATIO = 6.692 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 258.95 EU/100GMS

CHAMBER	FROZEN EXPANSION												THROAT
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	162.8
TEMP, DEG K	4548.4	3720.7	3036.2	2470.4	2241.0	2003.1	1617.1	1298.8	1037.2	823.4	649.9	510.2	3950.5
ENTHALPY (-)	.08	30.13	54.69	74.70	82.72	90.95	104.11	114.70	123.19	129.95	135.30	139.51	21.83
CP	.3649	.3610	.3562	.3508	.3479	.3443	.3368	.3285	.3200	.3118	.3047	.2984	.3620
IMPELL OPT	161.69	217.76	254.79	268.12	281.17	300.83	315.78	327.26	336.12	342.97	348.27	353.61	137.54
IMPELL VAC	245.60	268.75	250.14	258.60	307.15	320.43	330.77	338.81	345.05	349.88	353.61	242.27	
EPSILON	1.038	1.499	2.491	3.223	4.368	7.866	14.365	26.421	48.739	89.984	166.058	1.000	

CHAMBER	SHIFTING EXPANSION												THROAT
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	170.7
TEMP, DEG K	4548.4	4177.6	3851.6	3555.8	3423.4	3273.1	2980.4	2675.8	2415.6	2213.4	2051.6	1916.6	4302.3
ENTHALPY (-)	.08	31.39	59.39	84.53	95.39	107.14	127.43	145.44	161.36	175.57	188.38	200.06	20.78
X BAR	4.218	4.093	3.579	3.877	3.833	3.788	3.716	3.657	3.591	3.518	3.443	3.369	4.136
N	4.218	4.093	3.579	3.877	3.833	3.788	3.716	3.657	3.591	3.518	3.443	3.369	4.136
CP	1.7526	1.7603	1.6786	1.4719	1.3318	1.1486	.8178	.7355	.9157	1.1539	1.3763	1.5544	1.7652
IMPELL OPT	165.05	227.15	271.04	287.95	305.18	332.84	355.61	374.58	390.72	404.74	417.10	428.21	
IMPELL VAC	254.62	285.48	315.01	327.34	340.30	361.61	379.40	394.60	407.95	419.83	430.48	248.83	
EPSILON	1.061	1.650	2.968	3.993	5.658	11.061	21.831	43.860	90.084	188.283	398.653	1.000	

COMPOSITION SHIFTING (MOL/100 GM)													
132.60 F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.47 F*F	.7786	.7604	.7402	.7200	.7111	.7019	.6873	.6672	.6256	.5674	.5021	.4349	.7671
-133.84 F*F2	.1689	.1573	.1421	.1234	.1137	.1018	.0773	.0529	.0350	.0233	.0156	.0103	.1618
-270.00 F*F3	.0811	.1111	.1466	.1855	.2041	.2252	.2644	.3088	.3644	.4382	.5113	.5837	.0998
114.76 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
66.00 F*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 F*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
199.30 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-124.20 F3*H6*N3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.5364	.4059	.2875	.1828	.1395	.0953	.0335	.0069	.0013	.0003	.0001	.0000	.4505
-64.50 F*H	1.4457	1.5315	1.5540	1.6395	1.6553	1.6691	1.6772	1.6393	1.5437	1.4166	1.2785	1.1390	1.5050
58.60 F*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.3260	.2589	.2061	.1650	.1490	.1324	.1044	.0773	.0536	.0364	.0246	.0166	.2808
79.20 F*H	.0003	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
.00 F2	.0380	.0308	.0260	.0238	.0239	.0253	.0353	.0677	.1274	.1995	.2745	.3483	.0331
40.30 F2*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0042	.0021	.0010	.0004	.0003	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0027
.00 N2	.8341	.8353	.8359	.8362	.8363	.8363	.8364	.8364	.8364	.8364	.8364	.8364	.8350

SYSTEM LIQUID BIPROPELLANT										PC 300. PSIA		HEAT FORM		WT. G/G	
COMPONENT										DENSITY		(KCAL/POUN.WT.)		BT.	
TREF FORMULA										G/CC					
DEG K										1.500		-2.0		13.	
198 H2+H4										0.620		+7.74			
298 H2+H4															
FROZEN EXPANSION										C STAR = 6210.3 FT/SEC					
EPSILON	PC/F	P PSIA	TEMP	ENTHALPY	CP CAL / I OPT	DEL VAC	DEL VAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC		
			DEG K	KCAL/100GM	GM DEG	/P	LVL	10000	50000						
1.000	1.003	300.000	4548.4	-0.08	-365	137.5	104.7	232.8	235.7	241.2	242.3	1.206	1.259		
2.000	10.146	29.569	2681.5	-47.20	-353	242.3	39.7	1.341	262.3	268.2	279.7	1.359	1.461		
3.000	18.307	16.388	2301.8	-80.60	-349	264.7	31.7	1.936	267.9	276.5	293.1	1.388	1.535		
4.000	28.443	10.533	2048.4	-88.49	-345	277.7	27.2	2.579		278.3	300.4	1.509	1.598		
5.000	39.958	7.500	1906.2	-54.28	-343	286.3	24.3	3.236		305.0	310.5	1.609			
6.000	52.755	5.487	1783.8	-58.46	-340	292.6	22.2	3.907		308.1	314.8	1.631			
7.000	65.919	4.547	1686.8	-101.75	-338	297.4	20.7	4.546		310.3	318.1	1.648			
8.000	79.450	3.774	1607.2	-104.44	-337	301.3	19.4	5.153		312.0	320.8	1.662			
9.000	95.137	3.151	1536.8	-106.70	-335	304.6	18.4	5.844		313.8	324.9	1.673			
10.000	111.475	2.691	1481.9	-108.32	-332	307.3	17.6	6.530		314.3	324.9	1.683			
11.000	128.228	2.340	1431.5	-110.32	-332	309.7	16.8	7.200		314.3	326.5	1.692			
12.000	145.149	2.067	1386.8	-111.80	-331	311.8	16.2	7.844		314.6	328.0	1.699			
13.000	162.048	1.851	1347.0	-113.12	-330	313.6	15.7	8.458		314.8	329.2	1.706			
14.000	178.807	1.678	1311.1	-114.30	-329	316.7	14.7	9.078				1.712			
15.000	195.219	1.521	1278.4	-115.37	-328	318.0	14.7	9.678				331.4	1.717		
16.000	212.242	1.381	1248.5	-116.35	-327	318.0	14.3	10.365				332.4	1.722		
17.000	227.824	1.261	1220.9	-117.25	-326	319.3	13.9	11.052				333.7	1.726		
18.000	242.766	1.159	1195.5	-118.08	-325	320.4	13.5	11.740				334.0	1.730		
19.000	258.756	1.071	1171.9	-118.85	-325	321.4	13.3	12.409				334.7	1.734		
20.000	274.802	.995	1150.0	-119.56	-324	322.4	13.0	13.074				335.4	1.738		
21.000	290.918	.928	1129.4	-120.22	-323	323.3	12.7	13.727				336.0	1.741		
22.000	307.101	.869	1110.2	-120.84	-323	324.1	12.5	14.365				336.6	1.744		
23.000	323.364	.817	1092.0	-121.43	-322	324.8	12.3	14.999				337.1	1.747		
24.000	339.781	.772	1074.9	-121.98	-321	325.6	12.0	15.596				337.7	1.749		
25.000	356.354	.731	1058.8	-122.50	-321	326.3	11.8	16.187				338.2	1.752		
26.000	373.086	.694	1043.4	-122.99	-320	327.0	11.6	16.762				338.6	1.754		
27.000	389.970	.659	1028.6	-123.45	-320	327.6	11.5	17.331				339.0	1.757		
28.000	407.007	.624	1015.0	-123.90	-319	328.2	11.3	17.879				339.5	1.759		
29.000	424.197	.592	1001.7	-124.32	-319	328.8	11.1	18.745				339.9	1.761		
30.000	441.540	.563	989.1	-124.72	-318	329.3	11.0	19.450				340.2	1.763		
31.000	459.037	.536	977.0	-125.11	-318	329.8	10.8	20.134				340.6	1.765		
32.000	476.687	.512	965.4	-125.48	-317	330.3	10.7	20.803				340.9	1.767		
33.000	494.490	.489	954.3	-125.83	-317	330.7	10.5	21.446				341.3	1.768		
34.000	512.346	.469	943.7	-126.16	-317	331.2	10.4	22.072				341.6	1.770		
35.000	530.254	.449	933.4	-126.49	-316	331.6	10.3	22.684				341.9	1.771		
36.000	548.214	.431	923.4	-126.80	-316	332.0	10.2	23.281				342.3	1.773		
37.000	566.224	.415	914.1	-127.10	-315	332.4	10.0	24.170				342.6	1.774		
38.000	584.284	.399	904.9	-127.39	-315	332.8	9.8	24.825				342.7	1.775		
39.000	602.394	.385	896.1	-127.67	-315	333.2	9.8	25.477				343.0	1.777		
40.000	620.554	.372	887.5	-127.94	-314	333.5	9.7	26.112				343.2	1.778		
41.000	638.764	.359	879.3	-128.20	-314	333.9	9.6	26.734				343.5	1.779		
42.000	657.024	.347	871.3	-128.45	-314	334.2	9.5	27.348				343.7	1.781		
43.000	675.334	.336	863.5	-128.69	-313	334.5	9.4	27.954				343.9	1.782		
44.000	693.694	.326	856.0	-128.92	-313	334.8	9.3	28.551				344.1	1.783		
45.000	712.104	.316	848.8	-129.15	-313	335.1	9.2	29.141				344.3	1.785		
46.000	730.564	.307	841.7	-129.37	-313	335.4	9.1	29.722				344.5	1.787		
47.000	749.074	.299	834.8	-129.59	-312	335.7	9.1	30.305				344.7	1.786		
48.000	767.634	.291	828.2	-129.80	-312	335.9	9.0	30.939				344.9	1.787		
49.000	786.244	.283	821.7	-130.00	-312	336.2	8.9	31.537				345.1	1.788		
50.000	804.904	.276	815.5	-130.19	-312	336.5	8.9	32.130				345.3	1.789		
3.223	20.914	1.896	2251.0	-82.72	-338	298.1	30.5	2.074	248.1	277.3	295.1	2.986	1.389	1.350	

PRESSURE PROFILE DATA
 SYSTEM LIQUID PROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 CEG K GM/CC (KCAL/FORM.WT.)
 158 N2*F4 1.500 -2.0 90.
 258 H5*H9 0.620 +7.74 10.

PULK DENSITY = 1.314 GM/CC
 MIXTURE RATIO = 9.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 247.58 EU/100GMS

CHAMBER

THROAT

	FROZEN EXPANSION												
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	162.5
TEMP, DEG K	4563.6	3725.8	3035.0	2465.8	2235.3	1996.7	1610.5	1292.7	1032.0	819.2	646.7	507.9	3956.6
ENTHALPY (-)	.51	29.21	52.63	71.68	79.30	87.13	99.62	109.67	117.72	124.13	129.20	133.19	21.34
CP	.3442	.3409	.3369	.3322	.3296	.3266	.3198	.3123	.3047	.2973	.2908	.2849	.3417
IMPLL OPT	158.04	212.94	248.83	261.82	274.52	293.64	308.17	319.33	327.94	334.60	339.76	344.95	134.61
IMPLL VAC	239.96	262.47	283.27	291.49	299.80	312.70	322.75	330.56	336.62	341.32	344.95	346.75	
EPSILON	1.037	1.497	2.483	3.212	4.351	7.831	14.294	26.286	48.492	89.554	165.340	1.000	

	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	171.3
TEMP, DEG K	4563.6	4219.5	3926.1	3671.4	3563.1	3446.4	3244.2	3059.2	2886.0	2718.6	2546.2	2342.0	4335.3
ENTHALPY (-)	.51	30.50	57.43	81.78	92.37	103.92	124.15	142.70	159.76	175.46	189.91	203.10	20.21
X BAR	4.020	3.889	3.767	3.654	3.603	3.548	3.451	3.361	3.279	3.206	3.142	3.095	3.935
N	4.020	3.889	3.767	3.654	3.603	3.548	3.451	3.361	3.279	3.206	3.142	3.095	3.935
CP	2.1275	2.3787	2.5735	2.6837	2.7002	2.6908	2.5935	2.3836	2.0681	1.6451	1.1283	.6120	2.2922
IMPLL OPT	161.54	222.53	265.90	282.70	299.94	327.97	351.71	372.21	390.13	405.92	419.82	430.94	
IMPLL VAC	249.36	279.99	309.51	321.97	335.19	357.48	376.99	394.19	409.44	422.96	434.75	443.56	
EPSILON	1.062	1.659	3.006	4.063	5.798	11.588	23.687	49.169	103.096	217.103	453.981	1.000	

	COMPOSITION SHIFTING (MOL/100 GM)												
132.60 F	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-45.47 F*F	.4632	.4261	.3891	.3530	.3366	.3182	.2849	.2533	.2236	.1962	.1726	.1561	.4394
-133.84 F*F2	.1784	.1631	.1444	.1243	.1150	.1045	.0859	.0690	.0541	.0412	.0298	.0194	.1691
-270.00 F*F3	.1457	.2222	.2580	.3142	.3399	.3688	.4207	.4691	.5138	.5541	.5891	.6160	.1830
114.76 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
66.00 F*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 F*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
199.30 B2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-124.20 F3*H6*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.9453	.8128	.6695	.5751	.5246	.4692	.3715	.2815	.1992	.1253	.0619	.0161	.8589
-64.50 F*H	1.2464	1.2892	1.3197	1.3418	1.3501	1.3583	1.3708	1.3807	1.3885	1.3948	1.3997	1.4021	1.2757
58.60 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.1558	.1226	.0559	.0763	.0688	.0615	.0500	.0409	.0335	.0274	.0222	.0178	.1344
79.20 F*H	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
.00 F2	.0052	.0064	.0045	.0033	.0029	.0025	.0019	.0016	.0013	.0012	.0014	.0024	.0072
40.30 F2*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0044	.0024	.0013	.0007	.0005	.0004	.0002	.0001	.0001	.0000	.0000	.0000	.0029
.00 N2	.8630	.8640	.8646	.8649	.8650	.8651	.8652	.8652	.8652	.8652	.8652	.8653	.8637

SYSTEM LIQUID BIPROPELLANT										PC 300. PSIA		DENSITY		HEAT FORM		WT. 8/0	
COMPONENT										TREF FORMULA		GM/CC		(KCAL/FORM.WT.)		90.	
										100 N2/F4		1.500		-2.0		10.	
										298 854W9		0.670		+7.74			
										FROZEN EXPANSION		C STAR = 6000.0 FT/SEC					
										CP CAL / I OPT DELVAC DELVAC		I SEA		I AT		I VAC	
										GM DEG		LVL		10000		50000	
										C STAR = 6000.0 FT/SEC							
EPSILON	PC/F	P PSIA	TEMP	ENTHALPY	CP CAL / I OPT DELVAC DELVAC	GM DEG	I SEA	I AT	I VAC	CF SEA	CF VAC	LVL	LVL	LVL	LVL	LVL	LVL
			DEG K	KCAL/100GM													
1.000	1.000	300.000	4563.9	-51.344	130.9	112.0	233.9	236.8	242.4	243.4	1.235	1.184					
2.000	1.046	162.527	3956.6	-21.34	134.6	102.1	227.5	230.3	235.7	236.8	1.207	1.254					
3.000	1.088	28.445	2675.3	-64.71	134.6	131.0	256.2	262.0	273.2	275.4	1.359	1.461					
4.000	10.357	16.307	2293.6	-77.38	130.9	258.4	30.8	1.889	261.7	270.0	286.2	289.4	1.388	1.535			
5.000	28.444	10.475	2059.7	-85.07	127.2	266.4	2.519		271.8	283.3	297.6	1.579					
6.000	40.245	7.454	1897.0	-90.38	125.2	275.6	23.4	3.161		287.8	301.2	1.608					
7.000	53.088	5.651	1774.4	-94.35	123.2	285.7	21.6	3.816		300.8	307.3	1.630					
8.000	66.350	4.519	1677.5	-97.47	121.2	296.5	20.1	4.439		302.9	310.5	1.647					
9.000	80.043	3.748	1597.9	-100.02	120.2	294.2	18.9	5.035		304.5	311.1	1.661					
10.000	95.811	3.131	1530.7	-102.12	118.2	297.4	17.9	5.710		305.5	315.3	1.672					
11.000	112.246	2.672	1472.9	-104.00	117.0	300.1	17.0	6.380		306.2	317.1	1.682					
12.000	129.128	2.323	1422.5	-105.59	116.3	302.4	16.3	7.033		306.7	318.7	1.690					
13.000	146.146	2.053	1378.0	-107.00	115.5	304.4	15.7	7.661		307.0	320.1	1.698					
14.000	163.121	1.839	1338.3	-108.24	114.7	306.2	15.2	8.258		307.3	321.3	1.704					
15.000	179.967	1.667	1302.5	-109.36	113.7	307.7	14.7	8.823			322.4	1.710					
16.000	196.750	1.509	1270.0	-110.38	112.7	309.2	14.3	9.456			323.4	1.716					
17.000	213.921	1.370	1240.1	-111.31	111.7	310.5	13.9	10.128			324.4	1.720					
18.000	231.617	1.252	1212.8	-112.16	110.7	311.7	13.5	10.798			325.2	1.725					
19.000	249.740	1.151	1187.5	-112.94	109.7	312.8	13.2	11.460			326.0	1.729					
20.000	268.151	1.063	1164.0	-113.67	108.7	313.8	12.9	12.123			326.7	1.733					
21.000	287.000	0.987	1142.1	-114.34	107.6	314.7	12.6	12.771			327.3	1.736					
22.000	306.218	0.921	1121.7	-114.97	106.5	315.4	12.3	13.407			327.9	1.739					
23.000	325.718	0.863	1102.5	-115.56	105.4	316.4	12.1	14.030			328.5	1.742					
24.000	345.570	0.812	1084.5	-116.11	104.3	317.1	11.9	14.636			329.0	1.745					
25.000	365.745	0.766	1067.5	-116.63	103.2	317.9	11.7	15.228			329.5	1.748					
26.000	386.215	0.726	1051.4	-117.13	102.1	318.5	11.5	15.803			330.0	1.750					
27.000	406.975	0.690	1036.2	-117.59	101.0	319.2	11.3	16.362			330.4	1.753					
28.000	428.023	0.659	1021.7	-118.03	100.0	319.8	11.1	16.906			330.9	1.755					
29.000	449.366	0.631	1007.9	-118.45	99.0	320.3	10.9	17.445			331.3	1.757					
30.000	470.989	0.606	994.7	-118.85	98.0	320.9	10.8	18.000			331.6	1.759					
31.000	492.875	0.582	982.2	-119.23	97.0	321.4	10.6	18.533			332.0	1.761					
32.000	515.008	0.560	970.2	-119.58	96.0	321.9	10.5	19.052			332.4	1.763					
33.000	537.385	0.539	958.7	-119.94	95.0	322.3	10.3	19.558			332.7	1.765					
34.000	560.000	0.518	947.6	-120.28	94.0	322.8	10.2	20.051			333.0	1.766					
35.000	582.857	0.498	937.0	-120.60	93.0	323.2	10.1	20.531			333.3	1.768					
36.000	605.953	0.478	926.9	-120.90	92.0	323.6	10.0	21.000			333.6	1.769					
37.000	629.282	0.458	917.1	-121.19	91.0	324.0	9.8	21.460			333.9	1.771					
38.000	652.842	0.438	907.6	-121.48	90.0	324.4	9.7	21.910			334.1	1.772					
39.000	676.535	0.418	898.5	-121.76	89.0	324.8	9.6	22.348			334.4	1.774					
40.000	699.460	0.398	889.8	-122.02	88.0	325.1	9.5	22.778			334.6	1.775					
41.000	722.617	0.378	881.3	-122.27	87.0	325.5	9.4	23.200			334.9	1.776					
42.000	745.998	0.358	873.1	-122.52	86.0	325.8	9.3	23.618			335.1	1.777					
43.000	769.595	0.338	865.2	-122.76	85.0	326.1	9.2	24.028			335.3	1.779					
44.000	793.408	0.318	857.5	-122.99	84.0	326.4	9.1	24.432			335.6	1.780					
45.000	817.438	0.298	850.0	-123.21	83.0	326.7	9.0	24.831			335.8	1.781					
46.000	841.685	0.278	842.8	-123.42	82.0	327.0	8.9	25.226			336.0	1.782					
47.000	866.148	0.258	835.8	-123.63	81.0	327.3	8.9	25.618			336.2	1.783					
48.000	890.827	0.238	829.0	-123.84	80.0	327.6	8.8	26.007			336.3	1.784					
49.000	915.722	0.218	822.4	-124.03	79.0	327.8	8.7	26.393			336.5	1.785					
50.000	940.833	0.198	815.9	-124.22	78.0	328.1	8.6	26.778			336.7	1.786					
51.000	966.160	0.178	809.7	-124.41	77.0	328.3	8.6	27.160			336.9	1.787					
52.000	991.713	0.158	803.5	-124.59	76.0	328.6	8.5	27.539			337.1	1.788					
53.000	1017.492	0.138	797.3	-124.77	75.0	328.8	8.4	27.916			337.3	1.789					
54.000	1043.497	0.118	791.1	-124.94	74.0	329.1	8.3	28.291			337.5	1.790					
55.000	1069.728	0.098	784.9	-125.11	73.0	329.3	8.2	28.664			337.7	1.791					
56.000	1096.185	0.078	778.7	-125.28	72.0	329.6	8.1	29.035			337.9	1.792					
57.000	1122.868	0.058	772.5	-125.44	71.0	329.8	8.0	29.404			338.1	1.793					
58.000	1149.777	0.038	766.3	-125.60	70.0	330.1	7.9	29.771			338.3	1.794					
59.000	1176.912	0.018	760.1	-125.75	69.0	330.3	7.8	30.136			338.5	1.795					
60.000	1204.273	0.000	753.9	-125.90	68.0	330.6	7.7	30.500			338.7	1.796					

SHIFTING EXPANSION																	
C STAR = 6347.4 FT/SEC																	
PSILON	PC/F	P PSIA	TEMP	ENTHALPY	CP CAL / I OPT DELVAC DELVAC	GM DEG	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC	CP SEA	CP VAC	LVL	LVL	LVL
			DEG K	KCAL/100GM													
1.000	1.000	300.000	4563.9	-51.344	130.9	112.0	233.9	236.8	242.4	243.4	1.235	1.184					
2.000	1.046	162.527	3956.6	-21.34	134.6	102.1	227.5	230.3	235.7	236.8	1.207	1.254					
3.000	1.088	28.445	2675.3	-64.71	134.6	131.0	256.2	262.0	273.2	275.4	1.359	1.461					
4.000	10.357	16.307	2293.6	-77.38	130.9	258.4	30.8	1.889	261.7	270.0	286.2	289.4	1.388	1.535			
5.000	28.444	10.475	2059.7	-85.07	127.2	266.4	2.519		271								
6.000	33.951	8.836	3435.7	-104.90	2.088	301.5	34.9	3.950									
7.000	41.951	7.213	3388.5	-109.49	2.675	308.2	33.5	4.638									
8.000	49.444	6.687	3348.9	-111.65	2.659	313.8	32.3	5.323									
9.000	57.337	6.177	3314.7	-113.85	2.643	319.3	31.3	6.008									
10.000	65.246	4.908	3284.9	-120.06	2.623	322.5	30.6	6.645									
11.000	72.987	4.104	3258.4	-122.71	2.604	326.1	29.9	7.267									
12.000	81.057	3.701	3234.6	-125.10	2.586	329.2	29.3	7.909									
13.000	89.466	3.287	3213.0	-127.28	2.567	332.1	28.7	8.571									
14.000	98.065	3.038	3193.3	-129.28	2.548	334.8	28.3	9.254									
15.000	107.964	2.779	3175.1	-131.09	2.530	337.1	27.8	10.013									
16.000	117.074	2.562	3158.2	-132.78	2.512	339.2	27.4	10.705									
17.000	126.178	2.278	3142.6	-134.35	2.494	341.2	27.1	11.387									
18.000	135.245	2.135	3127.9	-135.82	2.476	343.1	26.8	12.067									
19.000	144.231	2.080	3114.2	-137.20	2.459	344.9	26.4	12.713									
20.000	153.124	1.959	3101.2	-138.49	2.443	346.5	26.2	13.353									
21.000	161.904	1.853	3089.0	-139.72	2.426	348.0	25.9	13.978									
22.000	170.561	1.759	3077.4	-140.87	2.410	349.5	25.7	14.596									
23.000	179.086	1.681	3066.4	-141.95	2.394	350.9	25.4	15.209									
24.000	187.490	1.596	3056.0	-143.02	2.378	352.1	25.2	15.795									
25.000	197.880	1.516	3045.9	-144.02	2.364	353.3	25.0	16.491									
26.000	207.850	1.443	3036.4	-144.97	2.349	354.5	24.8	17.190									
27.000	217.972	1.375	3027.2	-145.88	2.335	355.6	24.6	17.893									
28.000	228.131	1.315	3018.1	-146.76	2.320	356.7	24.4	18.598									
29.000	238.336	1.259	3010.0	-147.60	2.304	357.7	24.3	19.286									
30.000	248.582	1.207	3001.8	-148.41	2.293	358.7	24.1	19.982									
31.000	258.856	1.159	2994.0	-149.18	2.278	359.7	24.0	20.674									
32.000	269.154	1.115	2986.4	-149.93	2.264	360.6	23.8	21.369									
33.000	279.451	1.074	2979.0	-150.66	2.253	361.4	23.7	22.053									
34.000	289.750	1.035	2972.0	-151.35	2.240	362.3	23.5	22.734									
35.000	300.038	1.000	2965.1	-152.03	2.228	363.3	23.4	23.413									
36.000	310.308	0.967	2958.5	-152.68	2.215	364.2	23.3	24.088									
37.000	320.552	0.936	2952.1	-153.32	2.203	364.8	23.2	24.752									
38.000	330.759	0.907	2945.8	-153.93	2.191	365.3	23.0	25.413									
39.000	340.929	0.880	2939.7	-154.53	2.179	366.1	22.9	26.067									
40.000	351.054	0.855	2933.8	-155.11	2.168	366.7	22.8	26.715									
41.000	361.126	0.831	2928.1	-155.67	2.156	367.2	22.7	27.358									
42.000	371.152	0.808	2922.5	-156.22	2.145	368.1	22.6	27.990									
43.000	381.118	0.787	2917.0	-156.75	2.134	368.7	22.5	28.618									
44.000	391.025	0.767	2911.7	-157.27	2.123	369.3	22.4	29.240									
45.000	400.872	0.748	2906.5	-157.78	2.112	369.8	22.3	29.857									
46.000	410.659	0.729	2901.4	-158.27	2.101	370.5	22.3	30.467									
47.000	420.383	0.714	2896.4	-158.75	2.091	371.0	22.2	31.057									
48.000	430.047	0.698	2891.6	-159.22	2.080	371.6	22.2	31.649									
49.000	439.651	0.682	2886.8	-159.68	2.070	372.1	22.0	32.236									
50.000	449.197	0.667	2882.1	-160.13	2.060	372.7	21.9	32.819									
5.0E3	20.514	1.4996	3383.1	-193.17	2.700	292.7	39.3	2.472	282.7	294.5	317.4	322.0	1.433	1.632			

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N_2H_4 - B_5H_9 SYSTEM

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT MC 1000 PSIA PE 0.1 PSIA
 COMPONENT REF FORMULA DENSITY HEAT FORM WT. P/O
 LEO K 1.004 116.22 (KCAL/1000 WT.)
 298 H₂O-H 1.004 116.22
 298 H₂O-F 1.004 116.22

G/LK DENSITY = 1.271 GM/CC
 MIXTURE RATIO = 1.174 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 552.22 EU/1000GMS

CHAMBER THRUST

	1000	598.1	158.5	64.10	25.12	14.10	11.00	5.291	1.585	0.631	0.251	0.100	0.050
PRESSURE, PSIA	1000	598.1	158.5	64.10	25.12	14.10	11.00	5.291	1.585	0.631	0.251	0.100	0.050
TEMP, DEG K	2732.5	2423.1	2152.2	1896.1	1666.0	1453.5	1259.2	1075.2	902.2	762.4	651.0	564.1	491.5
ENTHALPY (-)	-25.74	5.70	34.74	58.56	80.38	97.54	116.22	135.70	145.52	154.58	164.05	174.21	184.35
CP	1.0076	0.9924	0.9753	0.9571	0.9385	0.9200	0.9015	0.8834	0.8654	0.8475	0.8299	0.8124	0.7951
IMPUL OPT	155.90	227.26	271.12	304.12	328.68	350.56	369.75	386.37	399.53	409.28	416.54	422.22	426.42
IMPUL VAC	250.54	272.61	311.65	335.87	348.02	355.22	357.60	356.77	353.56	348.03	340.43	330.72	319.40
EPSILON	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

	1000	598.1	158.5	64.10	25.12	14.10	11.00	5.291	1.585	0.631	0.251	0.100	0.050
PRESSURE, PSIA	1000	598.1	158.5	64.10	25.12	14.10	11.00	5.291	1.585	0.631	0.251	0.100	0.050
TEMP, DEG K	2732.5	2423.1	2152.2	1896.1	1666.0	1453.5	1259.2	1075.2	902.2	762.4	651.0	564.1	491.5
ENTHALPY (-)	-25.74	5.70	34.74	58.56	80.38	97.54	116.22	135.70	145.52	154.58	164.05	174.21	184.35
X HAK	0.703	0.684	0.661	0.647	0.647	0.647	0.647	0.647	0.647	0.647	0.647	0.647	0.647
N	10.308	10.287	10.264	10.245	10.226	10.207	10.187	10.167	10.147	10.127	10.107	10.087	10.067
CP	1.0049	1.0000	0.9924	0.9753	0.9571	0.9385	0.9200	0.9015	0.8834	0.8654	0.8475	0.8299	0.8124
IMPUL OPT	166.67	227.26	271.12	304.12	328.68	350.56	369.75	386.37	399.53	409.28	416.54	422.22	426.42
IMPUL VAC	252.43	272.61	311.65	335.87	348.02	355.22	357.60	356.77	353.56	348.03	340.43	330.72	319.40
EPSILON	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

	1000	598.1	158.5	64.10	25.12	14.10	11.00	5.291	1.585	0.631	0.251	0.100	0.050
122.60 H	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
114.76 H+H	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
66.00 H+H2	0.0121	0.0041	0.0011	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
18.00 H+H3	0.0239	0.0133	0.0061	0.0030	0.0012	0.0007	0.0004	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
199.30 H2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
-124.20 H3+H+H3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
52.10 H	0.0527	0.0294	0.0130	0.0042	0.0019	0.0004	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
79.20 H+H	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.00 H2	6.5721	6.6078	6.6289	6.6400	6.6444	6.6455	6.6466	6.6467	6.6467	6.6467	6.6467	6.6467	6.6467
40.30 H2+N	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
-11.04 H3+N	0.0002	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
113.00 N	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.00 N2	0.0417	0.0099	0.0012	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.00 B/C	0.5145	0.2713	0.2654	0.2679	0.2697	0.2707	0.2709	0.2709	0.2709	0.2709	0.2709	0.2709	0.2709
-60.30 H+N/C	3.2263	3.3521	3.4376	3.4693	3.4949	3.5169	3.5369	3.5549	3.5699	3.5829	3.5949	3.6069	3.6189

SYSTEM LIQUID BIPHRELLANT										PC 1000, PSIA		PE 0.1, PSIA											
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/100GM	CP DEG	I OPT	DELVAL	DELVAL	I SEA	I AT	I VAC	CF SEA	CF VAC									
															COMPONENT	TREF FORMULA	DENSITY	HEAT FLOW	PE 0.1, PSIA				
																				LLG K	G/CC	KCAL/100P.W.T.	WT. U/O

EPSILON	PC/P	SHIFTING EXPANSION											
		C STAR = 0.000, V F/SEC											
		P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DELVAL	DELVAL	I SEA	I AT	I VAC	CF SEA	CF VAC
			DEG K	KCAL/100GM	GM UEL				LVL	1000G	1000G	LVL	LVL
1.000	1.000	1000.000	273.15	25.94	1.000								
1.000	1.750	571.911	2586.2	-6.43	1.328	130.4	114.5	.199	242.0	242.8	244.5	1.252	1.217
2.000	7.944	125.485	2189.4	-40.43	1.021	240.7	51.5	.408	246.6	247.8	271.3	2.920	1.469
3.000	14.503	86.749	2055.0	-56.78	.986	208.5	42.6	.618	302.0	304.0	310.1	3.111	1.505
4.000	21.109	67.513	1899.3	-67.22	.971	204.4	38.3	.821	310.4	312.5	324.4	3.277	1.568
5.000	28.787	54.737	1822.0	-74.87	.961	200.0	35.3	1.018	316.0	320.5	329.2	3.510	1.589
6.000	36.217	47.611	1761.8	-80.23	.954	195.9	33.4	1.206	319.5	326.8	335.2	3.727	1.607
7.000	44.010	42.722	1712.6	-84.70	.948	191.5	31.7	1.395	321.7	329.7	339.4	3.922	1.618
8.000	52.535	38.455	1671.2	-88.41	.944	187.0	30.4	1.584	323.9	334.0	344.6	4.065	1.624
9.000	61.180	34.365	1625.5	-92.17	.940	183.0	29.3	1.794	325.5	334.8	354.6	4.177	1.627
10.000	70.000	30.384	1586.5	-95.09	.936	178.5	28.4	1.989	327.5	334.5	364.5	4.259	1.631
11.000	79.280	26.613	1547.6	-97.60	.933	174.2	27.6	2.190	329.1	334.1	374.4	4.318	1.638
12.000	89.701	23.074	1508.7	-100.01	.931	170.0	26.9	2.389	330.4	333.5	384.3	4.369	1.640
13.000	100.214	19.762	1469.8	-102.11	.929	165.8	26.3	2.588	331.4	332.9	394.1	4.411	1.641
14.000	110.846	16.645	1430.5	-104.22	.926	161.6	25.8	2.788	332.4	332.4	403.8	4.445	1.642
15.000	121.555	13.643	1390.8	-106.36	.924	157.4	25.3	2.995	333.4	332.0	413.4	4.471	1.643
16.000	132.315	10.757	1351.2	-108.38	.922	153.2	24.8	3.202	334.4	331.5	422.9	4.490	1.644
17.000	143.114	7.965	1311.7	-110.27	.920	149.0	24.3	3.409	335.4	331.0	432.4	4.504	1.645
18.000	153.947	5.291	1272.0	-112.00	.918	144.8	23.8	3.615	336.4	330.5	441.9	4.514	1.646
19.000	164.812	2.702	1232.5	-113.57	.916	140.6	23.3	3.821	337.4	330.0	451.4	4.520	1.647
20.000	175.706	1.007	1193.2	-115.00	.914	136.4	22.8	4.024	338.4	329.5	460.9	4.524	1.648
21.000	186.626	5.448	1154.0	-116.34	.913	132.2	22.3	4.226	339.4	329.0	470.4	4.526	1.649
22.000	197.569	5.149	1114.7	-117.52	.911	128.0	21.8	4.425	340.4	328.5	479.9	4.527	1.650
23.000	208.531	4.873	1075.4	-118.55	.909	123.8	21.3	4.621	341.4	328.0	489.4	4.528	1.651
24.000	219.516	4.626	1036.1	-119.42	.908	119.6	20.8	4.814	342.4	327.5	498.9	4.529	1.652
25.000	230.521	4.403	996.8	-120.15	.907	115.4	20.3	5.005	343.4	327.0	508.4	4.530	1.653
26.000	241.544	4.202	957.4	-120.75	.905	111.2	20.0	5.199	344.4	326.5	517.9	4.531	1.654
27.000	252.584	4.019	917.5	-121.27	.904	107.0	20.0	5.372	345.4	326.0	527.4	4.532	1.655
28.000	263.641	3.853	878.0	-121.68	.903	102.8	20.0	5.578	346.4	325.5	536.9	4.533	1.656
29.000	274.714	3.700	838.0	-121.95	.902	98.6	20.0	5.791	347.4	325.0	546.4	4.534	1.657
30.000	285.801	3.559	798.0	-122.11	.901	94.4	20.0	6.004	348.4	324.5	555.9	4.535	1.658
31.000	296.901	3.430	758.0	-122.17	.900	90.2	20.0	6.218	349.4	324.0	565.4	4.536	1.659
32.000	308.014	3.311	718.0	-122.15	.899	86.0	20.0	6.432	350.4	323.5	574.9	4.537	1.660
33.000	319.140	3.202	678.0	-122.05	.898	81.8	20.0	6.645	351.4	323.0	584.4	4.538	1.661
34.000	330.278	3.104	638.0	-121.88	.897	77.6	20.0	6.858	352.4	322.5	593.9	4.539	1.662
35.000	341.428	3.016	598.0	-121.63	.896	73.4	20.0	7.070	353.4	322.0	603.4	4.540	1.663
36.000	352.589	2.938	558.0	-121.30	.895	69.2	20.0	7.282	354.4	321.5	612.9	4.541	1.664
37.000	363.761	2.869	518.0	-120.89	.894	65.0	20.0	7.493	355.4	321.0	622.4	4.542	1.665
38.000	374.944	2.809	478.0	-120.40	.893	60.8	20.0	7.702	356.4	320.5	631.9	4.543	1.666
39.000	386.138	2.758	438.0	-119.83	.892	56.6	20.0	7.910	357.4	320.0	641.4	4.544	1.667
40.000	397.342	2.716	398.0	-119.18	.891	52.4	20.0	8.117	358.4	319.5	650.9	4.545	1.668
41.000	408.556	2.682	358.0	-118.45	.890	48.2	20.0	8.322	359.4	319.0	660.4	4.546	1.669
42.000	419.779	2.657	318.0	-117.64	.889	44.0	20.0	8.526	360.4	318.5	669.9	4.547	1.670
43.000	430.993	2.632	278.0	-116.75	.888	39.8	20.0	8.727	361.4	318.0	679.4	4.548	1.671
44.000	442.216	2.607	238.0	-115.78	.887	35.6	20.0	8.927	362.4	317.5	688.9	4.549	1.672
45.000	453.439	2.582	198.0	-114.73	.886	31.4	20.0	9.125	363.4	317.0	698.4	4.550	1.673
46.000	464.662	2.557	158.0	-113.60	.885	27.2	20.0	9.322	364.4	316.5	707.9	4.551	1.674
47.000	475.885	2.532	118.0	-112.39	.884	23.0	20.0	9.518	365.4	316.0	717.4	4.552	1.675
48.000	487.108	2.507	78.0	-111.10	.883	18.8	20.0	9.714	366.4	315.5	726.9	4.553	1.676
49.000	498.331	2.482	38.0	-109.73	.882	14.6	20.0	9.909	367.4	315.0	736.4	4.554	1.677
50.000	509.554	2.457	-2.0	-108.28	.881	10.4	20.0	10.104	368.4	314.5	745.9	4.555	1.678
51.000	520.777	2.432	-42.0	-106.75	.880	6.2	20.0	10.299	369.4	314.0	755.4	4.556	1.679
52.000	532.000	2.407	-82.0	-105.14	.879	2.0	20.0	10.494	370.4	313.5	764.9	4.557	1.680
53.000	543.223	2.382	-122.0	-103.45	.878	-2.2	20.0	10.689	371.4	313.0	774.4	4.558	1.681
54.000	554.446	2.357	-162.0	-101.68	.877	-6.4	20.0	10.884	372.4	312.5	783.9	4.559	1.682
55.000	565.669	2.332	-202.0	-99.83	.876	-10.6	20.0	11.079	373.4	312.0	793.4	4.560	1.683
56.000	576.892	2.307	-242.0	-97.90	.875	-14.8	20.0	11.274	374.4	311.5	802.9	4.561	1.684
57.000	588.115	2.282	-282.0	-95.88	.874	-19.0	20.0	11.469	375.4	311.0	812.4	4.562	1.685
58.000	599.338	2.257	-322.0	-93.78	.873	-23.2	20.0	11.664	376.4	310.5	821.9	4.563	1.686
59.000	610.561	2.232	-362.0	-91.60	.872	-27.4	20.0	11.859	377.4	310.0	831.4	4.564	1.687
60.000	621.784	2.207	-402.0	-89.33	.871	-31.6	20.0	12.054	378.4	309.5	840.9	4.565	1.688
61.000	633.007	2.182	-442.0	-86.97	.870	-35.8	20.0	12.249	379.4	309.0	850.4	4.566	1.689
62.000	644.230	2.157	-482.0	-84.52	.869	-40.0	20.0	12.444	380.4	308.5	859.9	4.567	1.690
63.000	655.453	2.132	-522.0	-81.98	.868	-44.2	20.0	12.639	381.4	308.0	869.4	4.568	1.691
64.000	666.676	2.107	-562.0	-79.35	.867	-48.4	20.0	12.834	382.4	307.5	878.9	4.569	1.692
65.000	677.899	2.082	-602.0	-76.63	.866	-52.6	20.0	13.029	383.4	307.0	888.4	4.570	1.693
66.000	689.122	2.057	-642.0	-73.82	.865	-56.8	20.0	13.224	384.4	306.5	897.9	4.571	1.694
67.000	700.345	2.032	-682.0	-70.92	.864	-61.0	20.0	13.419	385.4	306.0	907.4	4.572	1.695
68.000	711.568	2.007	-722.0	-67.92	.863	-65.2	20.0	13.614	386.4	305.5	916.9	4.573	1.696
69.000	722.791	1.982	-762.0	-64.82	.862	-69.4	20.0	13.809	387.4	305.0	926.4	4.574	1.697
70.000	734.014	1.957	-802.0	-61.62	.861	-73.6	20.0	14.004	388.4	304.5	935.9	4.575	1.698
71.000	745.237	1.932	-842.0	-58.32	.860	-77.8	20.0	14.199	389.4	304.0	945.4	4.576	1.699
72.000	756.460	1.907	-882.0	-54.92	.859	-82.0	20.0	14.394	390.4	303.5	954.9	4.577	1.700
73.000	767.683	1.882	-922.0	-51.42	.858	-86.2	20.0	14.589	391.4	303.0	964.4	4.578	1.701
74.000	778.906	1.857	-962.0	-47.82	.857	-90.4	20.0	14.784	392.4	302.5	973.9	4.579	1.702
75.000	790.129	1.832	-1002.0	-44.12	.856	-94.6	20.0	14.979	393.4	302.0	983.4	4.580	1.703
76.000	801.352	1.807	-1042.0	-40.32	.855	-98.8	20.0	15.174	394.4	301.5	992.9	4.581	1.704
77.000	812.575	1.782	-1082.0	-36.42	.854	-103.0	20.0	15.369	395.4	301.0	1002.4	4.582	1.705
78.000	823.798	1.757	-1122.0	-32.42	.853	-107.2	20.0	15.564	396.4	300.5	1011.9	4.583	1.706
79.000	835.021	1.732	-1162.0	-28.32	.852	-111.4	20.0	15.759	397.4	300.0	1021.4	4.584	1.707
80.000	846.244	1.707	-1202.0	-24.12	.851	-115.6	20.0	15.954	398.4	299.5	1030.9	4.585	1.708
81.000	857.467	1.682	-1242.0	-19.82	.850	-119.8	20.0	16.149	399.4	299.0	1040.4	4.586	1.709
82.000	868.690	1.657	-1282.0	-15.42	.849	-124.0	20.0	16.344	400.4	298.5	1049.9	4.587	1.710
83.000	879.913	1.632	-1322.0	-10.92	.848	-128.2	20.0	16.539	401.4	298.0	1059.4	4.588	1.711

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 1000 PSIA PL 0.1 PSIA
COMPONENT TRF FORMULA DENSITY HEAT FLOW WT. 0/0
LEG K GM/CC (KCAL/HRK.WT.)
298 N2+H4 1.004 +12.05 56.
298 H2+H4 0.620 +7.74 44.

FULK DENSITY = .774 GM/CC
MIXTURE RATIO = 1.275 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 354.71 EU/100GMS

CHAMBER

THRUST

FROZEN EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	571.4
TEMP, DEG K	2801.7	2475.7	2187.3	1924.4	1689.1	1563.8	1478.6	1290.2	1121.9	971.8	838.2	717.5	2599.4
ENTHALPY (-)	-26.45	5.98	34.62	59.89	82.09	93.72	101.53	118.55	133.37	146.22	157.34	166.91	-6.26
CP	1.0074	.9873	.9698	.9520	.9337	.9233	.9141	.8911	.8683	.8444	.8193	.7914	.9929
IMPUL OPT	167.95	230.49	274.05	307.27	323.52	333.08	335.16	372.86	387.57	399.05	410.13	420.32	132.52
IMPUL VAC	253.60	245.63	214.85	189.21	151.42	119.43	97.26	390.34	402.14	412.63	420.32	426.40	
EPSILON	1.079	1.744	3.242	6.375	9.587	12.908	16.582	55.302	115.760	243.167	511.007	1.000	
SHIFTING EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	571.5
TEMP, DEG K	2801.7	2558.3	2249.1	2028.7	1788.5	1659.1	1571.1	1375.7	1200.4	1043.9	904.2	779.8	2659.5
ENTHALPY (-)	-26.45	6.37	35.91	62.14	85.30	97.48	105.67	123.55	139.17	152.78	164.59	174.80	-6.47
X BAR	6.721	6.662	6.645	6.638	6.636	6.635	6.635	6.635	6.635	6.635	6.635	6.635	6.681
N	10.163	10.125	10.122	10.120	10.118	10.118	10.118	10.118	10.118	10.118	10.118	10.118	10.137
CP	1.0233	1.3512	1.0070	.9878	.9509	.9334	.9207	.9026	.8804	.8573	.8331	.8071	1.5471
IMPUL OPT	169.02	232.71	277.60	311.78	328.34	339.02	341.22	372.57	384.86	407.66	418.42	421.84	131.84
IMPUL VAC	256.20	249.47	219.54	184.69	157.32	125.60	97.07	397.71	410.02	420.59	429.11	438.36	
EPSILON	1.085	1.766	3.295	6.493	9.776	13.176	17.198	56.733	119.126	251.035	529.831	1.000	
COMPOSITION SHIFTING (MOL/100 GPM)													
132.60 B	.0007	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
114.76 B+H	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
66.00 B+H2	.0151	.0058	.0009	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0089
18.00 B+H3	.0243	.0138	.0040	.0006	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0175
199.30 B2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-174.20 B3+H6+N3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.0659	.0409	.0184	.0063	.0016	.0007	.0003	.0000	.0000	.0000	.0000	.0000	.0512
79.20 F+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	6.5440	6.5819	6.6130	6.6249	6.6281	6.6287	6.6287	6.6290	6.6291	6.6291	6.6291	6.6291	6.6282
40.30 F2+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3+H	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
113.00 N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	.0707	.0195	.0085	.0064	.0061	.0061	.0061	.0061	.0061	.0061	.0061	.0061	.0454
.00 B/C	.0898	.0072	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0322
-60.30 B+N/C	3.3531	3.4556	3.4777	3.4819	3.4825	3.4826	3.4826	3.4826	3.4826	3.4826	3.4826	3.4826	3.4829

SYSTEM LIQUID BIPROPELLANT										PC 1000. PSIA		PE 0.1 PSIA	
COMPONENT										DENSITY		PLAT FORM	
REF FORMULA										WT. R/O			
LEW K										G/CC		1(CAL/F/IMP,XT.)	
298 N2H4										1.004		17.05	
298 B5H9										0.670		17.76	
FROZEN EXPANSION													
C STAR = 0.0171 FT/SEC													
1.000													
CP CAL/G DEG K										OPT DELTAVAC		DELTA VAC	
10000										LVL		LVL	
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PRESSURE PROFILE DATA
 SYSTEM LIQUID HIPROPELLANT PC 1000, PSIA PE 0.1 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FCKR WT. C/O
 CEG K GM/CC (KCAL/FORM.WT.)
 29H N2*H4 1.004 +12.05 5H.
 29H H5*H9 0.620 +7.74 42.

FULK DENSITY = .797 GM/CC
 MIXTURE RATIO = 1.381 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 556.37 ENT/100GMS

CHAMBER

THROAT

	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	570.7
PRESSURE, PSIA	2799.0	2467.4	2170.4	1904.6	1667.1	1540.9	1455.2	1265.9	1097.2	947.2	814.1	696.1	2592.7
TEMP, DEG K	-26.95	5.77	34.54	59.91	82.09	93.70	101.49	118.59	133.06	145.76	156.70	166.08	-6.53
ENTHALPY (-)	.9946	.9792	.9612	.9431	.9245	.9159	.9045	.8913	.8753	.8581	.8407	.8225	.9847
CP	168.72	231.37	274.88	307.99	325.97	334.27	335.58	335.10	334.62	333.70	332.79	331.79	133.29
IMPUL OPT	254.65	286.49	315.54	339.40	351.92	359.85	366.50	370.38	371.98	372.67	372.67	372.67	247.58
IMPUL VAC	1.078	1.737	3.222	6.322	9.495	12.772	16.236	20.440	25.628	31.795	38.947	47.000	1.000
EPSILON													

SHIFTING EXPANSION

	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	573.5
PRESSURE, PSIA	2799.0	2503.6	2216.0	1953.6	1713.7	1585.5	1498.5	1305.5	1133.5	980.1	844.0	724.2	2620.4
TEMP, DEG K	-26.95	5.97	35.21	61.01	85.68	95.54	103.52	120.84	135.90	148.96	160.22	169.91	-6.61
ENTHALPY (-)	6.797	6.776	6.765	6.761	6.759	6.759	6.757	6.759	6.759	6.759	6.759	6.759	6.783
X BAR	10.095	10.095	10.089	10.085	10.084	10.083	10.083	10.083	10.083	10.083	10.083	10.083	10.097
N	1.7610	1.0889	1.0066	.9619	.9341	.9149	.9102	.8860	.8635	.8394	.8150	.7875	1.1419
CP	169.24	232.55	276.63	310.22	328.43	336.90	338.56	336.39	331.19	321.52	308.52	293.02	133.02
IMPUL OPT	255.90	288.34	317.91	342.51	354.42	362.49	367.14	370.99	372.67	372.67	372.67	372.67	248.53
IMPUL VAC	1.081	1.747	3.248	6.348	9.528	12.902	16.552	20.440	25.615	31.799	38.947	47.000	1.000
EPSILON													

COMPOSITION SHIFTING (MOL/100 GM)

	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
132.6C B	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
114.76 B*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
66.00 P*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 B*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
199.3C B2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-124.2C B3*H6*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.1C F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
79.20 H*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.0C F2	6.5441	6.5441	6.5441	6.5441	6.5441	6.5441	6.5441	6.5441	6.5441	6.5441	6.5441	6.5441	6.5441
40.3C F2*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.0C H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.0C H2	.1604	.1500	.1479	.1477	.1476	.1476	.1476	.1476	.1476	.1476	.1476	.1476	.1523
-60.3C B*H/C	3.2983	3.3193	3.3236	3.3242	3.3243	3.3243	3.3243	3.3243	3.3243	3.3243	3.3243	3.3243	3.3143

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPHOPPELLANT PC 1000. PSIA PE 0.1 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/D
 DEG K (M/CC) (KCAL/FORM.WT.)
 29H N2OH4 1.604 +12.05 60.
 29H H5OH9 0.620 +1.74 40.

BULK DENSITY = .805 GM/CC
 MIXTURE RATIO = 1.500 LH OXIDIZER / LH OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 357.77 EU/100GMS

CHAMBER

THROAT

	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	569.4
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	569.4
TEMP, DEG K	2742.8	2409.3	2111.5	1845.6	1608.9	1483.3	1328.2	1210.6	1044.1	896.6	766.3	651.3	2534.5
ENTHALPY (-)	-27.46	5.10	33.65	58.65	80.47	71.85	99.47	115.95	130.14	142.44	152.75	161.70	-7.06
CP	.9842	.9681	.9498	.9108	.9117	.8998	.8896	.8667	.8432	.8188	.7923	.7636	.9738
IMPUL OPT	168.29	230.56	273.69	306.41	322.17	332.22	353.20	370.32	384.45	396.16	405.17	413.21	246.90
IMPUL VAC	253.84	285.29	313.99	337.79	349.68	357.43	373.64	387.17	394.59	407.71	415.45	424.90	246.90
EPSILON	1.076	1.729	3.199	6.256	9.376	12.593	25.765	53.239	110.621	230.469	440.250	1.000	

	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	571.5
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	571.5
TEMP, DEG K	2742.8	2435.4	2145.6	1880.5	1641.4	1514.7	1428.5	1248.3	1067.3	919.4	787.0	669.9	2554.0
ENTHALPY (-)	-27.46	5.24	34.10	59.45	81.61	73.18	100.92	117.70	132.21	144.72	155.45	164.61	-7.13
X BAR	6.912	6.895	6.887	6.884	6.883	6.883	6.883	6.883	6.883	6.883	6.883	6.883	6.900
N	10.064	10.059	10.053	10.050	10.047	10.044	10.044	10.044	10.044	10.044	10.044	10.044	10.061
CP	1.1621	1.0444	.9807	.9426	.9167	.9041	.8936	.8701	.8464	.8224	.7967	.7686	1.0413
IMPUL OPT	168.67	231.42	274.96	307.02	323.95	334.17	355.35	372.67	387.02	394.89	407.77	415.97	247.59
IMPUL VAC	254.74	286.62	315.66	339.74	351.78	359.63	376.09	389.76	401.15	410.63	418.12	427.59	247.59
EPSILON	1.078	1.737	3.217	6.293	9.442	12.666	25.977	53.725	111.745	233.100	446.345	1.000	

COMPOSITION SHIFTING (MOL/100 GM)

132.60 B	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
114.76 B+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
66.00 B+H2	.0047	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0012
18.00 B+H3	.0090	.0018	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0035
199.30 B2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-124.20 B3+6+H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.0541	.0242	.0084	.0022	.0004	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0347
79.20 H+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 H2	6.5475	6.5780	6.5849	6.5924	6.5934	6.5936	6.5936	6.5937	6.5937	6.5937	6.5937	6.5936	6.5695
40.30 H2+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 H3+N	.0006	.0003	.0002	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0004
113.00 N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	.2958	.2902	.2892	.2892	.2892	.2892	.2892	.2892	.2892	.2892	.2892	.2891	.2914
-60.30 B+N/C	3.1521	3.1637	3.1657	3.1659	3.1660	3.1660	3.1660	3.1660	3.1660	3.1660	3.1660	3.1660	3.1612

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Ford Motor Company,
AERONUTRONIC DIVISION

N_2O_4 - N_2H_4 SYSTEM

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA

COMPONENT	TREF FORMULA DEG K	DENSITY GM/CC	HEAT FORM (KCAL/FORM.WT.)	WT. O/F
29H	N2*O4	1.43	-5.4	40.
29B	N2*H4	1.004	12.05	60.

BULK DENSITY = 1.140 GM/CC
MIXTURE RATIO = .627 LB OXIDIZER / LB OF FUEL

PROF. PROFILE DATA

CHAMBER ENTROPY 316.55 EU/100GMS

	CHAMBER												THROAT
	FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	551.6
TEMP, DEG K	2564.1	2125.5	1750.4	1430.1	1157.3	1018.5	927.2	735.6	578.7	452.4	352.8	273.2	2273.0
ENTHALPY (-)	-20.21	5.73	27.17	44.76	59.06	66.08	70.58	79.77	87.03	92.73	97.15	100.65	-2.91
CP	.6000	.5819	.5606	.5366	.5120	.4985	.4890	.4700	.4558	.4469	.4412	.4374	.5884
IMPUL OPT		150.23	203.03	237.74	262.62	273.99	281.06	294.93	305.45	313.46	319.54	324.27	122.70
IMPUL VAC		224.34	248.19	269.25	285.70	293.46	298.34	308.00	315.38	321.02	325.33	328.68	219.74
EPSILON		1.058	1.620	2.839	5.224	7.532	9.823	18.655	35.598	64.118	130.873	250.867	1.000

	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	552.8
TEMP, DEG K	2564.1	2138.2	1764.0	1442.3	1167.9	1028.2	936.3	743.5	586.1	463.6	384.7	339.1	2284.5
ENTHALPY (-)	-20.21	5.80	27.36	45.07	59.49	66.56	71.10	80.37	87.70	93.47	98.07	101.92	-2.93
X BAR	6.059	6.052	6.051	6.051	6.051	6.051	6.051	6.050	6.047	6.026	5.931	5.765	6.054
N	6.059	6.052	6.051	6.051	6.051	6.051	6.051	6.050	6.047	6.026	5.931	5.765	6.054
CP	.6439	.5928	.5628	.5376	.5130	.4995	.4901	.4721	.4651	.4526	.4421	1.5653	.6070
IMPUL OPT		150.44	203.44	238.32	263.32	274.75	281.85	295.81	306.40	314.49	320.79	325.96	122.63
IMPUL VAC		224.81	248.81	269.98	286.52	294.33	299.23	308.96	316.40	322.17	326.93	331.15	220.13
EPSILON		1.059	1.623	2.845	5.237	7.552	9.852	18.720	35.769	69.009	138.773	293.987	1.000

COMPOSITION SHIFTING (MOL/100 GM)													
52.10	H	.0139	.0026	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0050
79.20	H=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-10.00	H=N=O	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
9.33	H=O	.0028	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0007
.00	H2	1.9998	2.0040	2.0051	2.0052	2.0052	2.0051	2.0049	2.0040	1.9994	1.9682	1.8254	1.5766
40.30	H2=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80	H2=O	1.7355	1.7385	1.7388	1.7388	1.7388	1.7388	1.7388	1.7388	1.7388	1.7388	1.7388	1.7380
-11.04	H3=N	.0004	.0003	.0002	.0002	.0002	.0003	.0004	.0010	.0041	.0249	.1201	.2860
113.00	N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
21.65	N=O	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
8.06	N=O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00	N2	2.3064	2.3067	2.3068	2.3068	2.3068	2.3067	2.3067	2.3064	2.3049	2.2945	2.2469	2.1639
19.50	N2=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56	O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00	O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA PE 0.5 PSIA

COMPONENT	TREF FORMULA	DENSITY	HEAT FURN	WT. Q/D										
					DEG K	GA/CC	TREAL/FORN.WT.1							
298	N2+O2	1.43	-5.4	40.										
298	N2+O2	1.004	12.05	60.										
FROZEN EXPANSION														
C STAR = 5440.2 FT/SEC														
EPILION	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DEL VAC	DEL VAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC
			DEG K	KCAL/100GM	GN DEG		/P	/P	LVL	10000	50000		LVL	
1.000	1.000	1000.000	2544.1	20.21	.000									
2.000	9.779	102.259	1613.0	-34.83	.551	219.4	37.8	.370	217.2	217.9	219.4	219.7	1.234	1.249
3.000	17.378	57.586	1602.4	-46.23	.536	240.4	30.5	.531	263.2	265.5	270.1	271.0	1.498	1.580
4.000	27.445	36.411	1248.9	-53.29	.522	252.9	26.2	.720	268.6	271.8	277.9	279.2	1.527	1.587
5.000	37.581	26.409	1174.9	-60.16	.516	261.1	23.4	.885	271.7	275.6	283.2	284.7	1.544	1.618
6.000	48.983	20.415	1102.8	-61.84	.507	267.2	21.6	1.059	273.2	277.9	287.0	288.6	1.553	1.642
7.000	61.301	16.313	1045.0	-64.75	.501	271.9	20.1	1.234	273.9	279.3	289.9	292.0	1.557	1.660
8.000	74.344	13.451	997.1	-67.18	.498	275.7	18.9	1.409		280.2	292.2	294.6	1.561	1.675
9.000	88.232	11.334	956.4	-69.15	.492	278.8	18.0	1.585		280.5	294.7	296.8	1.567	1.687
10.000	102.663	9.741	921.3	-70.87	.488	281.5	17.1	1.760			295.6	298.6	1.569	1.698
11.000	118.194	8.461	890.5	-72.37	.485	283.8	16.4	1.942			296.9	300.2	1.570	1.707
12.000	134.619	7.439	863.2	-73.70	.482	285.8	15.8	2.126			298.0	301.7	1.571	1.715
13.000	151.708	6.613	839.7	-74.88	.480	287.6	15.3	2.308			299.0	302.9	1.572	1.722
14.000	168.451	5.937	816.5	-75.94	.478	289.2	14.8	2.490			299.7	304.0	1.574	1.728
15.000	185.867	5.377	794.4	-76.90	.476	290.7	14.3	2.666			300.5	305.0	1.574	1.734
16.000	203.707	4.909	774.0	-77.77	.474	292.0	14.0	2.844			301.1	305.9	1.575	1.739
17.000	221.559	4.513	761.0	-78.58	.472	293.3	13.6	3.012			301.6	306.8	1.576	1.744
18.000	239.458	4.176	745.3	-79.32	.471	294.5	13.3	3.177			302.1	307.5	1.576	1.748
19.000	258.200	3.873	730.7	-80.00	.470	295.3	13.0	3.347			302.5	308.2	1.577	1.752
20.000	278.900	3.586	717.0	-80.64	.468	296.2	12.7	3.516			302.9	308.9	1.578	1.756
21.000	300.097	3.332	704.3	-81.24	.467	297.1	12.4	3.678			303.2	309.5	1.579	1.759
22.000	321.313	3.108	692.3	-81.80	.466	297.9	12.2	3.834			303.4	310.1	1.579	1.763
23.000	343.739	2.909	681.0	-82.32	.465	298.7	11.9	4.005			303.6	310.6	1.579	1.766
24.000	366.061	2.732	670.4	-82.82	.464	299.4	11.7	4.293			303.8	311.1	1.579	1.769
25.000	388.635	2.573	660.3	-83.29	.463	300.1	11.5	4.679			304.0	311.6	1.579	1.771
26.000	411.402	2.431	650.8	-83.73	.462	300.7	11.3	5.065			304.1	312.0	1.579	1.774
27.000	434.308	2.303	642.7	-84.15	.461	301.3	11.2	5.451			304.2	312.5	1.579	1.776
28.000	457.301	2.187	635.1	-84.54	.460	301.9	11.0	5.822			304.3	312.9	1.579	1.778
29.000	480.334	2.082	628.0	-84.92	.460	302.4	10.8	6.198			304.4	313.3	1.579	1.781
30.000	503.368	1.987	621.0	-85.28	.459	303.0	10.7	6.569			304.5	313.6	1.579	1.783
31.000	526.360	1.900	609.5	-85.63	.458	303.5	10.5	6.937			304.5	314.0	1.579	1.785
32.000	549.289	1.821	602.3	-85.94	.458	303.9	10.4	7.302			304.6	314.3	1.579	1.787
33.000	572.129	1.748	595.4	-86.27	.457	304.4	10.2	7.666			304.6	314.6	1.579	1.788
34.000	594.864	1.681	588.8	-86.57	.457	304.8	10.1	8.019			304.9	314.9	1.579	1.790
35.000	617.488	1.619	582.4	-86.84	.456	305.2	10.0	8.372			305.0	315.2	1.579	1.792
36.000	641.025	1.559	576.3	-87.14	.456	305.6	9.9	8.738			305.1	315.5	1.579	1.793
37.000	664.432	1.496	570.4	-87.41	.455	306.0	9.8	9.107			305.2	315.8	1.579	1.795
38.000	688.601	1.438	564.7	-87.67	.455	306.4	9.7	9.476			305.3	316.0	1.579	1.796
39.000	723.111	1.383	559.2	-87.92	.454	306.7	9.5	9.805			305.3	316.3	1.579	1.798
40.000	750.962	1.332	554.9	-88.17	.454	307.1	9.4	10.095			305.4	316.5	1.579	1.799
41.000	779.071	1.284	548.7	-88.40	.453	307.4	9.3	10.384			305.4	316.7	1.579	1.800
42.000	807.478	1.238	543.7	-88.62	.453	307.7	9.3	10.673			305.5	317.0	1.579	1.802
43.000	836.182	1.196	538.9	-88.84	.453	308.0	9.2	10.962			305.5	317.2	1.579	1.803
44.000	865.038	1.158	534.5	-89.05	.452	308.3	9.1	11.251			305.6	317.4	1.579	1.804
45.000	894.150	1.118	529.7	-89.26	.452	308.6	9.0	11.539			305.6	317.6	1.579	1.805
46.000	923.452	1.083	525.3	-89.44	.452	308.9	8.9	11.826			305.7	317.8	1.579	1.806
47.000	952.926	1.049	521.1	-89.65	.451	309.2	8.8	12.112			305.7	318.0	1.579	1.808
48.000	982.584	1.018	516.8	-89.84	.451	309.5	8.7	12.397			305.8	318.2	1.579	1.809
49.000	1012.298	.988	512.9	-89.99	.451	309.7	8.7	12.681			305.8	318.4	1.579	1.810
50.000	1042.161	.960	509.0	-90.20	.451	309.9	8.6	12.964			305.9	318.5	1.579	1.811
7.532	68.046	14.696	1018.5	-66.08	.498	274.0	19.5	1.325	274.0	279.9	291.2	293.5	1.557	1.668

SHIFTING EXPANSION

C STAR = 5475.4 FT/SEC														
EPILION	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DEL VAC	DEL VAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC
			DEG K	KCAL/100GM	GN DEG		/P	/P	LVL	10000	50000		LVL	
1.000	1.000	1000.000	2544.1	20.21	.000									
2.000	1.809	552.264	2284.5	2.93	.607	122.6	97.5	.774	217.5	218.3	219.8	220.1	1.248	1.233
3.000	9.740	102.264	1627.4	-35.01	.552	219.8	38.0	.370	252.3	254.0	257.2	257.8	1.431	1.461
4.000	17.319	57.742	1615.7	-46.50	.535	240.9	30.7	.532	263.8	266.2	270.7	271.6	1.498	1.580
5.000	27.373	36.512	1281.3	-53.62	.526	251.5	26.9	.722	269.3	272.5	278.6	279.9	1.527	1.587
6.000	37.442	26.404	1184.4	-58.53	.515	261.7	23.7	.888	272.4	276.3	283.9	285.4	1.544	1.618
7.000	48.801	20.491	1114.0	-62.23	.508	267.8	21.8	1.062	274.0	278.7	287.8	289.4	1.553	1.642
8.000	61.071	16.374	1055.8	-65.17	.502	272.4	20.3	1.237	274.6	280.1	290.7	292.8	1.557	1.660
9.000	74.047	13.505	1007.6	-67.58	.497	275.8	19.1	1.412			294.1	296.5	1.561	1.675
10.000	87.874	11.380	964.7	-69.41	.493	279.5	18.1	1.590			294.3	299.7	1.567	1.687
11.000	102.225	9.782	931.4	-71.34	.490	282.2	17.3	1.765			294.5	299.5	1.569	1.698
12.000	117.675	8.498	900.3	-72.86	.488	284.6	16.5	1.947			297.8	301.1	1.570	1.707
13.000	133.817	7.473	872.8	-74.19	.486	286.8	15.9	2.131			298.9	302.5	1.571	1.715
14.000	150.521	6.644	848.2	-75.38	.481	288.5	15.4	2.315			299.8	303.8	1.572	1.722
15.000	167.640	5.944	825.9	-76.45	.479	290.0	14.9	2.497			300.6	304.9	1.574	1.728
16.000	185.111	5.402	805.6	-77.42	.477	291.5	14.5	2.678			301.3	305.9	1.574	1.734
17.000	202.767	4.932	787.0	-78.31	.476	292.8	14.1	2.851			302.0	306.8	1.575	1.739
18.000	220.536	4.534	769.9	-79.12	.474	294.0	13.7	3.021			302.5	307.7	1.576	1.744
19.000	238.352	4.195	754.1	-79.87	.473	295.1	13.4	3.186			303.0	308.4	1.576	1.748
20.000	256.045	3.903	739.4	-80.54	.472	296.1	13.1	3.355			303.4	309.2	1.577	1.752
21.000	277.420	3.605	725.7	-81.20	.470	297.0	12.8	3.525			303.8	309.8	1.578	1.756
22.000	298.691	3.350	712.8	-81.81	.468	297.9	12.5	3.695			304.1	310.4	1.578	1.760
23.000	319.997	3.125	700.8	-82.37	.467	298.7	12.3	3.825			304.3	311.0	1.579	1.763
24.000	341.876	2.925	689.4	-82.90	.466	299.5	12.0	4.000			304.5	311.6	1.579	1.766
25.000	364.008	2.747	678.7	-83.40	.465	300.2	11.8	4.175			304.7	312.1	1.579	1.769
26.000	386.512	2.587	668.4	-83.87	.464	300.9	11.6	4.349			304.9	312.5	1.579	1.772
27.000	409.187	2.444	659.0	-84.32	.463	301.6	11.4	4.525			305.0	313.0	1.579	1.774
28.000	431.919	2.315	649.8	-84.74	.463	302.2	11.2	4.697			305.1	313.4	1.579	1.777
29.000	454.774	2.199	641.1	-85.14	.463	302.8	11.0	4.867			305.2	313.8	1.579	1.779
30.000	477.644	2.094	633.0	-85.52	.463	303.3	10.9	5.012			305.3	314.2	1.579	1.781
31.000	500.551	1.998	625.2	-85.89	.463	303.8	10.8	5.165			305.4	314.6	1.579	1.783
32.000	523.392	1.911	617.7	-86.23	.463	304.3	10.6	5.356			305.5	314.9	1.579	1.785
33.000	546.151	1.831	610.5	-86.57	.463	304.8	10.5	5.520			305.6	315.2	1.579	1.787
34.000	568.827	1.758	603.7	-86.89	.463	305.2	10.3	5.681			305.7	315.5	1.579	1.789
35.000	591.379	1.691	597.1	-87.19	.464	305.7	10.2	5.839			305.9	315.9	1.579	1.791
36.000	613.802	1.629	590.8	-87.48	.465	306.1	10.1	5.993			306.1	316.2	1.579	1.792
37.000	637.033	1.570	584.7	-87.76	.466	306.5	10.0	6.153			306.3	316.5	1.579	1.794
38.000	659.577	1.515	578.8	-88.03	.466	306.9	9.9	6.317			306.5	316.7	1.579	1.796
39.000	690.472	1.468	573.1	-88.30	.466	307.2	9.7	6.472			306.7	317.0	1.579	1.797
40.000	717.898	1.393	567.6	-88.55	.465	307.6	9.6	6.622			306.9	317.3	1.579	1.799
41.000	745.233	1.342	562.4	-88.79	.465	307.9	9.5	6.712			307.1	317.5	1.579	1.800
42.000	773.054	1.293	557.3	-89.02	.465	308.3	9.4	6.802			307.3	317.7	1.579	1.801
43.000	801.140	1.248	552.3	-89.25	.465	308.6	9.3	6.893			307.5	317.9	1.579	1.802
44.000	829.467	1.206	547.4	-89.47	.466	309.0	9.3	6.983			307.7	318.2	1.579	1.804
45.000	858.012	1.165	543.0	-89.69	.467	309.2	9.2	7.072			307.9	318.4	1.579	1.805
46.000	886.797	1.125	538.7	-89.90	.467	309.5	9.1	7.162			308.1	318.6	1.579	1.806
47.000	915.645	1.092	534.3	-90.09	.469	309.6	9.0	7.250			308.3	318.8	1.579	1.807
48.000	944.729	1.059	530.1	-90.27	.470	310.1	8.9	7.343			308.5	319.0	1.579	1.808
49.000	973.920	1.027	526.1	-90.47	.471	310.3	8.9	7.424			308.7	319.2	1.579	1.809
50.000	1003.317	998	522.2	-90.66	.471	310.6	8.8	7.509			308.9	319.4	1.579	1.810
51.000	1032.599	968	518.3	-90.83	.472	310.8	8.7	7.593			309.1	319.5	1.579	1.811
7.552	88.044	14.096	1022.2	-64.54	.500	274.7	19.0	1.332	274.7	280.6	292.1	294.3	1.558	1.641

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA

COMPONENT	TREF FORMULA DEG K	DENSITY GM/CC	HEAT FORM (KCAL/FORM.WT.)	WT. 070
298 N2O4		1.43	-5.4	48.
298 N2H4		1.004	12.05	52.

BULK DENSITY = 1.172 GM/CC
MIXTURE RATIO = .923 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 302.75 EU/100GMS

CHAMBER													THROAT
FROZEN EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	554.9
TEMP, DEG K	2959.7	2480.7	2068.7	1714.2	1409.4	1252.2	1147.8	925.4	738.4	584.0	458.5	358.8	2645.1
ENTHALPY (-)	-16.73	10.21	32.75	51.49	66.96	74.64	79.62	89.89	98.12	104.66	109.82	113.84	1.04
CP	.5694	.5554	.5381	.5183	.4957	.4818	.4724	.4494	.4309	.4162	.4065	.4006	.5605
IMPUL OPT	153.11	207.49	243.63	269.83	281.95	289.53	304.56	316.10	324.98	331.81	337.04	337.04	124.35
IMPUL VAC	229.10	254.25	276.63	294.33	302.78	308.12	318.81	327.06	333.41	338.29	342.04	342.04	224.12
EPSILON	1.062	1.641	2.902	5.425	7.684	10.343	19.911	38.454	74.302	143.519	277.726	1.000	

	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	559.4
TEMP, DEG K	2959.7	2535.2	2134.4	1775.9	1464.3	1303.3	1196.2	967.3	774.2	614.0	433.9	305.0	2690.4
ENTHALPY (-)	-16.73	10.46	33.48	52.73	68.64	76.62	81.77	92.41	100.97	107.79	113.14	117.42	.92
X BAR	5.425	5.399	5.391	5.390	5.389	5.389	5.389	5.389	5.389	5.389	5.387	5.365	5.406
N	5.425	5.399	5.391	5.390	5.389	5.389	5.389	5.389	5.389	5.389	5.387	5.365	5.406
CP	.7334	.6150	.5545	.5236	.4994	.4859	.4761	.4552	.4437	.4387	.4356	.4304	.6513
IMPUL OPT	153.81	209.02	245.84	272.59	284.98	292.73	308.14	320.00	329.14	336.19	341.63	341.63	123.94
IMPUL VAC	230.75	256.61	279.49	297.62	306.29	311.77	322.77	331.27	337.83	342.89	346.86	346.86	225.40
EPSILON	1.066	1.656	2.941	5.494	7.994	10.497	20.257	39.216	75.519	147.118	288.148	1.000	

COMPOSITION SHIFTING (MOL/100 GM)													
52.10 H	.0421	.0140	.0029	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0721
79.20 H+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-10.00 H+N+O	.0018	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0008
9.33 H+O	.0251	.0056	.0007	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0105
.00 H2	1.1554	1.1551	1.1574	1.1583	1.1585	1.1585	1.1584	1.1583	1.1578	1.1543	1.1218	1.1544	
40.30 H2+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2+N	2.0551	2.0799	2.0858	2.0865	2.0866	2.0866	2.0866	2.0866	2.0866	2.0866	2.0866	2.0866	2.0739
-11.04 H3+N	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0001	.0001	.0005	.0028	.0245	.0001
113.00 N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
21.65 N+O	.0033	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0011
8.06 N+O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	2.1416	2.1437	2.1441	2.1442	2.1442	2.1442	2.1442	2.1442	2.1441	2.1440	2.1428	2.1320	2.1432
19.50 N2+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
.00 O2	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001

SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA

EPSILON	PC/P	P PSIA	TEMP DEG K	ENTHALPY KCAL/100GM	CP CAL/ I OPT	DELTA VAC DELTA VAC	I SEA LVL	I AT 10000	I AT 50000	I VAC	CF SEA LVL	CF VAC LVL
1.000	1.002	1000.000	2959.7	16.73	509	124.4	90.8	180	221.5	222.3	223.8	224.1
2.000	1.455	105.760	1920.5	-1.27	551	225.2	90.8	377	257.5	259.2	262.4	263.1
3.000	14.685	80.004	1497.5	-52.30	517	245.2	32.5	541	269.7	272.1	276.7	277.4
4.000	26.207	38.158	1550.1	-59.91	507	258.3	28.1	736	275.6	278.0	285.1	286.4
5.000	35.819	27.918	1645.7	-65.15	499	266.9	25.4	900	278.9	283.0	290.8	292.3
6.000	46.165	21.641	1565.3	-69.13	492	273.3	23.4	1081	280.9	285.6	294.9	296.7
7.000	57.407	17.359	1500.4	-72.31	484	278.3	21.9	1262	281.7	287.5	298.1	300.2
8.000	69.488	14.391	1246.4	-74.92	481	282.4	20.7	1439	283.5	290.6	303.1	305.1
9.000	82.262	12.159	1200.3	-77.13	477	285.8	19.7	1620	284.8	292.7	305.5	307.7
10.000	95.410	10.481	1160.4	-79.03	474	288.6	18.9	1799	286.0	294.6	307.5	310.0
11.000	108.298	9.149	1125.2	-80.49	470	291.1	18.1	1981	287.9	296.9	309.3	312.0
12.000	123.970	8.066	1093.9	-82.16	467	293.3	17.5	2168	289.1	298.1	310.8	313.7
13.000	139.174	7.185	1065.7	-83.87	464	295.3	16.9	2356	290.2	300.2	312.7	315.6
14.000	156.806	6.460	1040.1	-85.45	462	297.0	16.4	2542	291.1	301.4	314.4	317.3
15.000	170.744	5.856	1016.7	-86.73	459	298.8	15.9	2727	291.9	302.5	316.5	319.0
16.000	186.960	5.349	995.3	-87.71	457	300.0	15.4	2909	292.6	303.6	318.5	321.5
17.000	203.305	4.919	975.5	-88.42	455	301.3	15.2	3087	293.1	304.5	320.5	323.5
18.000	219.733	4.551	957.1	-88.85	453	302.5	14.8	3260	293.7	305.7	322.5	325.5
19.000	236.191	4.234	940.0	-89.23	451	303.6	14.5	3429	294.1	306.7	324.5	327.5
20.000	252.856	3.955	924.0	-89.45	450	304.4	14.2	3597	294.5	307.5	326.5	329.5
21.000	271.679	3.681	908.9	-89.62	448	305.6	13.9	3760	294.9	308.4	328.5	331.5
22.000	290.941	3.437	894.8	-89.76	447	306.5	13.7	3918	295.4	309.2	330.5	333.5
23.000	310.578	3.220	881.4	-89.85	445	307.4	13.4	4077	295.7	310.0	332.5	335.5
24.000	330.542	3.028	868.7	-89.87	444	308.2	13.2	4235	296.0	310.8	334.5	337.5
25.000	350.787	2.851	856.8	-89.85	443	308.9	13.0	4392	296.3	311.6	336.5	339.5
26.000	371.267	2.693	845.4	-89.85	442	309.6	12.8	4549	296.5	312.4	338.5	341.5
27.000	391.936	2.551	834.5	-89.73	441	310.3	12.6	4706	296.8	313.2	340.5	343.5
28.000	412.752	2.423	824.2	-89.59	440	311.0	12.4	4863	297.0	314.0	342.5	345.5
29.000	433.672	2.306	814.3	-89.42	439	311.5	12.3	5019	297.1	314.7	344.5	347.5
30.000	454.659	2.199	804.9	-89.25	438	312.1	12.1	5176	297.2	315.4	346.5	349.5
31.000	475.678	2.102	795.8	-89.03	437	312.7	11.9	5332	297.3	316.1	348.5	351.5
32.000	496.699	2.013	787.1	-88.77	436	313.2	11.8	5489	297.4	316.8	350.5	353.5
33.000	517.693	1.932	778.8	-88.47	435	313.7	11.7	5645	297.5	317.5	352.5	355.5
34.000	538.638	1.857	770.8	-88.12	434	314.2	11.5	5802	297.6	318.2	354.5	357.5
35.000	559.516	1.787	763.0	-87.75	433	314.6	11.4	5959	297.7	318.9	356.5	359.5
36.000	580.313	1.721	755.6	-87.36	433	315.1	11.2	6116	297.8	319.6	358.5	361.5
37.000	601.018	1.664	748.4	-86.94	432	315.5	11.1	6273	297.9	320.3	360.5	363.5
38.000	621.627	1.609	741.5	-86.49	431	315.9	11.0	6430	298.0	321.0	362.5	365.5
39.000	642.138	1.552	734.8	-86.02	431	316.3	10.9	6587	298.1	321.7	364.5	367.5
40.000	662.524	1.496	728.3	-85.54	430	316.7	10.8	6744	298.2	322.4	366.5	369.5
41.000	682.891	1.443	722.0	-85.03	429	317.1	10.7	6901	298.3	323.1	368.5	371.5
42.000	703.144	1.392	715.9	-84.50	429	317.4	10.6	7058	298.4	323.8	370.5	373.5
43.000	723.364	1.345	710.0	-83.94	428	317.8	10.5	7215	298.5	324.5	372.5	375.5
44.000	743.548	1.301	704.3	-83.35	428	318.1	10.4	7372	298.6	325.2	374.5	377.5
45.000	763.698	1.259	698.7	-82.74	427	318.4	10.3	7529	298.7	325.9	376.5	379.5
46.000	783.807	1.219	693.3	-82.10	426	318.8	10.2	7686	298.8	326.6	378.5	381.5
47.000	803.877	1.181	688.1	-81.43	426	319.1	10.1	7843	298.9	327.3	380.5	383.5
48.000	823.907	1.146	683.0	-80.74	425	319.4	10.0	8000	299.0	328.0	382.5	385.5
49.000	843.897	1.112	678.0	-80.01	425	319.6	9.9	8157	299.1	328.7	384.5	387.5
50.000	863.845	1.080	673.1	-79.25	425	319.9	9.9	8314	299.2	329.4	386.5	389.5
7.999	68.046	14.696	1252.2	-74.64	482	282.0	20.8	1417	282.0	288.2	302.8	304.8

SHIFTING EXPANSION

EPSILON	PC/P	P PSIA	TEMP DEG K	ENTHALPY KCAL/100GM	C STAR = 5455.5 P/PSIE		I SEA LVL	I AT 10000	I AT 50000	I VAC	CF SEA LVL	CF VAC LVL
					CP CAL/ I OPT	DELTA VAC						
1.000	1.788	559.422	2690.4	-9.2	651	123.9	101.5	181	222.7	223.5	225.4	225.4
2.000	9.262	107.973	2001.0	-40.83	540	228.1	40.9	379	259.7	261.3	265.2	265.2
3.000	78.369	81.083	1735.0	-35.31	525	248.8	35.5	545	272.1	274.6	280.2	280.2
4.000	25.747	38.840	1614.3	-61.10	511	260.3	28.8	742	278.2	281.5	287.9	287.9
5.000	35.236	28.380	1507.3	-64.53	503	269.2	26.1	918	281.7	285.8	293.7	293.7
6.000	45.306	22.072	1426.9	-70.44	494	275.7	24.1	1091	283.8	288.6	297.9	297.9
7.000	56.525	17.691	1356.4	-73.93	491	280.8	22.5	1276	286.7	292.3	301.2	301.2
8.000	68.136	14.681	1303.0	-76.65	486	285.0	21.1	1451	289.4	295.9	310.3	310.3
9.000	80.592	12.408	1255.7	-78.92	482	288.5	20.3	1635	292.0	306.0	308.7	308.7
10.000	93.482	10.697	1216.7	-80.88	478	291.4	19.4	1815	294.2	307.5	310.8	310.8
11.000	106.966	9.349	1178.5	-82.61	474	294.0	18.7	2000	296.2	309.2	312.7	312.7
12.000	121.270	8.246	1146.3	-84.13	471	296.4	18.0	2186	298.1	311.5	314.3	314.3
13.000	136.099	7.348	1117.5	-85.49	468	298.2	17.5	2375	299.8	313.7	317.0	317.0
14.000	151.354	6.607	1091.0	-86.72	464	300.0	16.9	2564	301.4	316.0	320.0	320.0
15.000	166.940	5.990	1067.0	-87.84	463	301.6	16.5	2751	302.9	318.4	322.5	322.5
16.000	182.747	5.471	1044.9	-88.86	461	303.1	16.1	2939	304.3	320.4	326.5	326.5
17.000	198.753	5.031	1024.5	-89.80	459	304.4	15.7	3115	305.5	322.4	328.5	328.5
18.000	214.829	4.655	1005.5	-90.67	457	305.7	15.3	3292	306.7	324.4	330.5	330.5
19.000	230.943	4.330	987.9	-91.47	455	306.8	15.0	3468	307.9	326.4	332.5	332.5
20.000	247.058	4.048	971.4	-92.22	454	307.9	14.7	3645	309.0	328.4	334.5	334.5
21.000	263.163	3.776	955.9	-92.93	452	308.9	14.4	3818	310.1	330.4	336.5	336.5
22.000	283.540	3.527	941.2	-93.59	451	309.8	14.2	4003	311.1	332.4	338.5	338.5
23.000	302.631	3.304	927.4	-94.21	449	310.7	13.9	4190	312.1	334.4	340.5	340.5
24.000	322.045	3.105	914.4	-94.79	448	311.5	13.7	4378	313.1	336.4	342.5	342.5
25.000	341.744	2.926	902.0	-95.35	447	312.3	13.5	4567	314.1	338.4	344.5	344.5
26.000	361.688	2.765	890.2	-95.87	445	313.0	13.2	4757	315.1	340.4	346.5	346.5
27.000	381.822	2.619	879.0	-96.35	444	313.7	13.1	4948	316.1	342.4	348.5	348.5
28.000	402.118	2.487	868.3	-96.85	443	314.3	12.9	5140	317.1	344.4	350.5	350.5
29.000	422.531	2.367	858.1	-97.30	442	315.0	12.7	5332	318.1	346.4	352.5	352.5
30.000	443.024	2.257	848.3	-97.73	441	315.6	12.5	5525	319.1	348.4	354.5	354.5
31.000	463.544	2.157	839.0	-98.14	440	316.1	12.4	5719	320.1	350.4	356.5	356.5
32.000	484.119	2.066	830.0	-98.54	439	316.7	12.2	5914	321.1	352.4	358.5	358.5
33.000	504.682	1.982	821.3	-98.92	438	317.2	12.1	6109	322.1	354.4	360.5	360.5
34.000	525.169	1.904	813.0	-99.28	438	317.7	11.9	6304	323.1	356.4	362.5	362.5
35.000	545.620	1.838	805.0	-99.63	437	318.2	11.8	6491	324.1	358.4	364.5	364.5
36.000	566.000	1.767	797.3	-99.97	436	318.6	11.7	6679	325.1	360.4	366.5	366.5
37.000	586.299	1.699	789.9	-100.29	435	319.0	11.6	6868	326.1	362.4	368.5	368.5
38.000	606.503	1.634	782.7	-100.60	435	319.5	11.4	7058	327.1	364.4	370.5	370.5
39.000	626.616	1.566	775.7	-100.90	434	319.9	11.3	7249	328.1	366.4	372.5	372.5
40.000	646.671	1.500	769.0	-101.20	433	320.4	11.2	7440	329.1	368.4	374.5	374.5
41.000	666.675	1.435	762.5	-101.48	433	320.8	11.1	7632	330.1	370.4	376.5	376.5
42.000	687.511	1.374	756.1	-101.75	432	321.1	11.0	7825	331.1	372.4	378.5	378.5
43.000	721.924	1.305	750.0	-102.02	431	321.4	10.9	8018	332.1	374.4	380.5	380.5
44.000	746.585	1.239	744.1	-102.27	431	321.8	10.8	8213	333.1	376.4	382.5	382.5
45.000	771.473	1.175	738.3	-102.51	430	322.1	10.7	8408	334.1	378.4	384.5	384.5
46.000	796.577	1.115	732.7	-102.76	429	322.4	10.6	8603	335.1	380.4	386.5	386.5
47.000	821.880	1.057	727.2	-103.00	429	322.7	10.5	8797	336.1	382.4	388.5	388.5
48.000	847.369	1.001	721.9	-103.22	428	323.1	10.4	8991	337.1	384.4	390.5	390.5
49.000	873.028	0.946	716.7	-103.43	428	323.4	10.3	9186	338.1	386.4	392.5	392.5
50.000	898.845	0.893	711.7	-103.64	427	323.6	10.2	9381	339.1	388.4	394.5	394.5
7.994	68.046	14.696	1303.3	-76.62	486	285.0	21.3	1451	289.4	303.8	310.3	310.3

PRESSURE PROFILE DATA
 SYSTEM LIQUID PROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 298 N2*O4 1.43 -5.4 52.
 298 N2*H4 1.004 +12.05 48.

PULK DENSITY = 1.188 GM/CC
 MIXTURE RATIO = 1.043 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTRUPY 294.97 EU/100GMS

CHAMBER	FROZEN EXPANSION												THROAT
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	556.6
TEMP, DEG K	3129.7	2635.0	2208.8	1840.9	1523.5	1359.3	1249.8	1015.2	816.0	649.4	512.6	402.2	2806.6
ENTHALPY (-)	-15.00	12.00	34.67	53.63	69.38	77.25	82.36	92.96	101.53	108.38	113.81	118.08	2.71
CP	.5518	.5391	.5240	.5059	.4853	.4724	.4625	.4403	.4199	.4032	.3910	.3834	.5438
IMPUL OPT	153.25	207.87	244.35	270.94	283.28	291.03	306.47	318.39	327.62	334.75	340.26	340.26	124.10
IMPUL VAC	229.46	254.97	277.74	295.86	304.55	310.07	321.15	329.75	336.41	341.54	345.50	345.50	224.34
EPSILON	1.063	1.650	2.939	5.509	8.036	10.569	20.479	39.798	77.320	150.031	290.924	1.000	
SHIFTING EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	565.7
TEMP, DEG K	3129.7	2735.4	2340.5	1969.2	1639.3	1467.5	1352.8	1105.6	894.3	716.0	568.0	447.7	2886.6
ENTHALPY (-)	-15.00	12.40	35.95	55.89	72.56	80.92	86.38	97.73	106.96	114.39	120.31	125.00	2.41
X BAR	5.127	5.083	5.064	5.059	5.058	5.058	5.058	5.058	5.058	5.058	5.058	5.057	5.096
N	5.127	5.083	5.064	5.059	5.058	5.058	5.058	5.058	5.058	5.058	5.058	5.057	5.096
CP	.8586	.6768	.5674	.5193	.4934	.4801	.4706	.4478	.4261	.4074	.3936	.3892	.7394
IMPUL OPT	154.39	210.53	248.33	275.99	288.87	296.97	313.16	325.73	335.51	343.10	348.99	348.99	123.06
IMPUL VAC	232.24	259.20	283.01	301.97	311.09	316.89	328.60	337.73	344.84	350.34	354.60	354.60	226.41
EPSILON	1.071	1.681	3.009	5.661	8.276	10.905	21.231	41.472	80.968	157.768	307.006	1.000	
COMPOSITION SHIFTING (MOL/100 GM)													
52.10 F	.0551	.0240	.0070	.0012	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0343
19.20 H2O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-10.00 H2O2	.0036	.0012	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0019
9.33 H2O	.0063	.0200	.0038	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0324
.00 H2	.7587	.7377	.7340	.7346	.7350	.7350	.7350	.7350	.7350	.7349	.7347	.7326	.7430
40.30 H2+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-37.80 H2+O	2.1772	2.2351	2.2560	2.2601	2.2605	2.2605	2.2605	2.2605	2.2605	2.2605	2.2605	2.2605	2.2182
-11.04 H3+N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	.0002	.0016	.0000
113.00 N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
21.65 N+O	.0109	.0027	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0050
8.06 N+O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	2.0556	2.0609	2.0626	2.0628	2.0629	2.0629	2.0629	2.0629	2.0629	2.0628	2.0628	2.0621	2.0594
19.50 N2+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
39.56 O	.0026	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0009
.00 O2	.0030	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0011

SYSTEM LIQUID RIPOPELLANT										PC 1000. PSIA		DENSITY		HEAT FORM		WT. 0/0	
COMPONENT										TREF FORTALL		GM/CC		(KCAL/FORM.WT.)			
DEG K										298 42004		1.43		-5.4		52.	
										298 42046		1.004		+12.05		68.	

PRESSURE PROFILE DATA
 SYSTEM LIQUID R1PROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 298 N2*O4 1.43 -5.4 57.
 298 N2*H4 1.004 +12.05 43.

PULK DENSITY = 1.209 GM/CC
 MIXTURE RATIO = 1.326 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 284.38 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	556.3
TEMP, DEG K	3252.7	2749.1	2314.1	1937.9	1612.4	1443.5	1330.8	1087.9	880.2	704.7	559.0	440.2	2923.6
ENTHALPY (-)	-12.82	13.46	35.62	54.24	64.78	77.58	82.67	93.25	101.86	108.79	114.32	118.69	4.42
CP	.5272	.5159	.5022	.4863	.4676	.4555	.4467	.4249	.4040	.3863	.3725	.3634	.5202
IMPUL OPT		151.20	205.30	241.55	268.08	280.44	288.22	303.78	315.87	325.27	332.58	338.25	122.47
IMPUL VAC		226.56	252.02	274.80	293.01	301.78	307.36	318.62	327.42	334.25	339.55	343.64	221.41
EPSILON		1.064	1.658	2.963	5.580	8.163	10.761	20.965	40.974	80.026	155.943	303.299	1.000
	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	571.2
TEMP, DEG K	3252.7	2922.1	2592.1	2244.8	1900.1	1714.4	1589.4	1317.8	1082.2	879.4	707.2	563.2	3050.4
ENTHALPY (-)	-12.82	14.06	37.77	58.40	76.02	84.95	90.82	103.15	113.33	121.64	128.37	133.75	3.91
X BAR	4.794	4.723	4.673	4.650	4.645	4.645	4.645	4.645	4.645	4.645	4.645	4.645	4.749
N	4.794	4.723	4.673	4.650	4.645	4.645	4.645	4.645	4.645	4.645	4.645	4.645	4.749
CP	1.0893	.9178	.7124	.5513	.4903	.4742	.4647	.4429	.4208	.3994	.3815	.3670	.9908
IMPUL OPT		152.93	209.77	248.93	278.01	291.66	300.28	317.64	331.28	342.03	350.48	357.09	120.66
IMPUL VAC		230.95	259.71	285.18	305.46	315.26	321.53	334.30	344.40	352.35	358.58	363.43	224.45
EPSILON		1.079	1.733	3.162	6.014	8.839	11.697	23.028	45.546	90.048	177.505	348.537	1.000
	COMPOSITION SHIFTING (MOL/100 GM)												
52.10 H	.0509	.0273	.0117	.0034	.0006	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0356
19.20 H*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-10.00 H*N*O	.0070	.0035	.0014	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0047
9.33 H*O	.1331	.0738	.0294	.0063	.0006	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0956
.00 H2	.3544	.2823	.2304	.2089	.2057	.2056	.2056	.2056	.2056	.2056	.2056	.2056	.3088
40.30 H2*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2*O	2.2335	2.3489	2.4318	2.4696	2.4771	2.4777	2.4778	2.4778	2.4778	2.4778	2.4778	2.4778	2.3067
-11.04 H3*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
21.65 N*O	.0372	.0184	.0061	.0009	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0250
8.06 N*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	1.9390	1.9502	1.9575	1.9606	1.9611	1.9612	1.9612	1.9612	1.9612	1.9612	1.9612	1.9612	1.9463
19.50 N2*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.0111	.0043	.0009	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0065
.00 O2	.0279	.0145	.0041	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0196

SYSTEM LIQUID RIPOPELLANT										PC 1000. PSIA		DENSITY		HEAT FORM		WT. O/O		
COMPONENT										TREF FORMULA		GM/CC		(KCAL/FORM.WT.)				
DEF K										298 N240N		1.43		-5.4		57.		
298 N240N										1.0004		-0.004		+12.05		43.		
FROZEN EXPANSION										C STAR = 5722.1 FT/SEC								
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP	CAL/1	OPT	DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC			
			DEG K	KCAL/100GM	GM	DEG	/F	LVL	LVL	10000	50000	50000	LVL					
1.000	1.000	1000.000	3252.7	-4.42	-520	127.5	98.9	-178	218.8	219.6	221.1	221.4	1.230	1.245				
2.000	9.224	108.408	2174.4	-42.42	-497	220.2	40.3	-372	255.0	256.6	259.8	260.4	1.434	1.464				
3.000	16.167	61.854	1910.8	-54.59	-486	242.2	33.0	-534	267.4	269.7	274.3	275.2	1.503	1.547				
4.000	25.326	39.485	1774.9	-62.11	-478	255.4	28.7	-728	273.4	276.7	282.9	284.1	1.537	1.598				
5.000	34.587	28.912	1664.1	-67.36	-471	264.1	24.1	-907	277.0	281.0	286.7	290.2	1.557	1.632				
6.000	44.221	22.613	1578.8	-71.35	-465	270.6	24.2	-1069	279.1	283.8	293.0	294.8	1.569	1.658				
7.000	55.048	18.166	1509.7	-74.55	-460	275.7	22.7	-1249	280.0	285.6	296.3	298.4	1.575	1.678				
8.000	66.199	15.106	1452.0	-77.19	-456	279.8	21.5	-1424	280.4	286.7	298.9	301.3	1.577	1.694				
9.000	78.084	12.407	1402.8	-79.43	-452	283.3	20.5	-1602										
10.000	90.428	11.054	1359.9	-81.36	-449	286.2	19.7	-1781										
11.000	103.148	9.693	1322.1	-83.05	-446	288.8	19.0	-1957										
12.000	116.745	8.566	1288.3	-84.55	-443	291.1	18.3	-2142										
13.000	130.816	7.644	1257.4	-85.90	-441	293.1	17.6	-2327										
14.000	145.246	6.883	1230.2	-87.11	-438	294.9	17.3	-2512										
15.000	160.058	6.246	1204.9	-88.22	-436	296.5	16.8	-2696										
16.000	175.140	5.710	1181.6	-89.23	-434	298.0	16.4	-2878										
17.000	190.348	5.254	1160.1	-90.14	-432	299.3	16.1	-3057										
18.000	205.656	4.862	1140.0	-91.03	-430	300.6	15.7	-3232										
19.000	221.012	4.525	1121.3	-91.83	-428	301.7	15.4	-3404										
20.000	236.314	4.231	1103.8	-92.58	-426	302.8	15.1	-3571										
21.000	251.587	3.972	1087.4	-93.28	-425	303.8	14.8	-3735										
22.000	266.814	3.713	1071.8	-93.93	-423	304.8	14.6	-3896										
23.000	281.956	3.482	1057.1	-94.56	-422	305.6	14.3	-4051										
24.000	305.357	3.274	1043.2	-95.14	-421	306.5	14.1	-4208										
25.000	323.878	3.088	1030.0	-95.70	-419	307.3	13.9	-4359										
26.000	342.463	2.919	1017.4	-96.22	-418	308.0	13.7	-4504										
27.000	361.534	2.766	1005.5	-96.72	-417	308.7	13.5	-4649										
28.000	380.634	2.627	994.0	-97.20	-416	309.4	13.3	-4797										
29.000	399.868	2.501	983.1	-97.65	-415	310.0	13.1	-4938										
30.000	419.273	2.385	972.2	-98.08	-414	310.6	12.9	-5081										
31.000	438.667	2.280	962.5	-98.50	-412	311.2	12.8	-5218										
32.000	458.051	2.183	952.8	-98.90	-411	311.8	12.7	-5350										
33.000	477.519	2.094	943.6	-99.28	-411	312.3	12.5	-5478										
34.000	496.955	2.012	934.6	-99.65	-410	312.8	12.4	-5603										
35.000	516.371	1.937	926.0	-100.00	-409	313.3	12.2	-5724										
36.000	535.737	1.867	917.7	-100.34	-408	313.8	12.1	-5843										
37.000	555.040	1.802	909.6	-100.67	-407	314.2	12.0	-5959										
38.000	574.288	1.741	901.8	-100.98	-406	314.7	11.9	-6071										
39.000	593.414	1.685	894.3	-101.28	-405	315.1	11.8	-6181										
40.000	612.472	1.633	887.0	-101.58	-405	315.5	11.7	-6287										
41.000	631.525	1.583	880.0	-101.87	-404	315.9	11.5	-6392										
42.000	650.552	1.529	873.1	-102.15	-403	316.3	11.4	-6497										
43.000	669.625	1.478	866.5	-102.42	-403	316.6	11.3	-6597										
44.000	688.712	1.430	860.0	-102.68	-402	317.0	11.2	-6692										
45.000	707.763	1.385	853.7	-102.93	-401	317.3	11.1	-6783										
46.000	726.804	1.341	847.6	-103.17	-401	317.7	11.1	-6874										
47.000	745.846	1.300	841.7	-103.41	-400	318.0	11.0	-6959										
48.000	764.810	1.262	835.9	-103.64	-400	318.3	10.9	-7043										
49.000	783.711	1.225	830.3	-103.87	-399	318.6	10.8	-7126										
50.000	802.534	1.190	824.8	-104.09	-398	318.9	10.7	-7206										
8.163	68.046	14.696	1443.5	-77.58	-456	280.4	21.3	-1.452	280.4	286.9	299.3	301.8	1.577	1.697				

SHIFTING EXPANSION																
C STAR = 5846.4 FT/SEC																
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP	CAL/1	OPT	DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC	
			DEG K	KCAL/100GM	GM	DEG	/F	LVL		LVL	10000	50000	LVL			
1.000	1.000	1000.000	3252.7	-4.42	-520	127.5	98.9	-178	218.8	219.6	221.1	221.4	1.230	1.245		
2.000	8.307	120.383	2594.1	-43.42	-484	221.6	45.1	-374	261.2	262.8	266.0	266.7	1.437	1.468		
3.000	15.081	68.310	2273.3	-54.86	-481	244.4	36.9	-537	275.1	277.6	282.3	283.9	1.514	1.559		
4.000	22.757	43.942	2114.6	-65.31	-520	240.8	32.5	-740	282.4	285.7	292.0	293.3	1.556	1.614		
5.000	31.306	31.943	1995.2	-71.35	-501	270.7	29.6	-925	286.6	290.7	298.6	300.2	1.577	1.652		
6.000	39.638	25.190	1901.2	-75.96	-490	277.9	27.5	-1091	289.4	294.2	303.5	305.4	1.592	1.681		
7.000	49.402	20.242	1825.0	-79.87	-483	283.7	25.8	-1276	290.8	296.4	307.3	309.5	1.600	1.703		
8.000	59.436	16.402	1761.0	-82.74	-478	288.3	24.5	-1457	291.4	297.9	310.4	312.9	1.604	1.722		
9.000	69.780	14.331	1706.1	-85.35	-474	292.2	23.4	-1636								
10.000	80.747	12.381	1658.4	-87.60	-470	295.6	22.5	-1820								
11.000	92.033	10.466	1616.1	-89.58	-467	298.5	21.7	-2001								
12.000	103.619	9.649	1578.4	-91.33	-464	301.3	21.1	-2182								
13.000	115.949	8.868	1544.3	-92.91	-461	303.3	20.4	-2370								
14.000	128.827	7.774	1511.3	-94.27	-457	307.2	19.9	-2569								
15.000	141.646	7.000	1484.9	-95.64	-457	302.4	19.4	-2749								
16.000	154.928	6.455	1458.7	-96.83	-454	308.9	19.0	-2937								
17.000	168.412	5.938	1434.4	-97.93	-453	310.4	18.6	-3124								
18.000	182.039	5.441	1411.9	-98.95	-451	312.9	18.2	-3310								
19.000	195.759	5.108	1390.8	-99.90	-449	313.2	17.8	-3490								
20.000	209.526	4.773	1371.0	-100.79	-447	314.4	17.5	-3680								
21.000	223.365	4.478	1352.4	-101.62	-444	315.5	17.2	-3833								
22.000	237.069	4.218	1334.8	-102.40	-444	316.6	16.9	-4013								
23.000	250.802	3.980	1318.1	-103.14	-443	317.7	16.7	-4200								
24.000	266.409	3.754	1302.5	-103.83	-442	318.6	16.4	-4373								
25.000	282.346	3.542	1287.5	-104.49	-440	319.5	16.2	-4569								
26.000	298.534	3.350	1273.2	-105.12	-439	320.3	16.0	-4768								
27.000	314.949	3.175	1259.4	-105.71	-438	321.1	15.7	-4970								
28.000	331.552	3.016	1246.6	-106.28	-437	321.9	15.5	-5155								
29.000	348.329	2.871	1234.1	-106.83	-435	322.6	15.4	-5349								
30.000	365.248	2.738	1222.2	-107.34	-434	323.3	15.2	-5546								
31.000	382.284	2.614	1210.7	-107.84	-433	324.0	15.0	-5735								
32.000	399.411	2.504	1199.7	-108.32	-432	324.7	14.8	-5925								
33.000	416.647	2.400	1189.1	-108.78	-431	325.3	14.7	-6114								
34.000	433.848	2.305	1178.9	-109.22	-430	325.8	14.5	-6301								
35.000	451.114	2.217	1169.0	-109.64	-429	326.4	14.4	-6486								
36.000	468.385	2.135	1159.5	-110.05	-428	327.0	14.2	-6670								
37.000	485.644	2.059	1150.2	-110.44	-428	327.5	14.1	-6848								
38.000	502.875	1.989	1141.3	-110.82	-427	328.0	14.0	-7025								
39.000	520.066	1.923	1132.7	-111.19	-426	328.5	13.8	-7200								
40.000	537.263	1.861	1124.3	-111.55	-425	328.9	13.7	-7372								
41.000	554.478	1.801	1116.2	-111.91	-424	329.3	13.6	-7541								
42.000	571.704	1.750	1108.4	-112.23	-423	329.8	13.5	-7708								
43.000	588.914	1.700	1100.7	-112.55	-423	330.3	13.4	-7871								
44.000	605.086	1.653	1093.3	-112.86	-422	330.7	13.3	-8032								
45.000	621.236	1.611	1086.2	-113.17	-421	331.2	13.2	-8191								
46.000	636.896	1.563	1079.0	-113.46	-420	331.5	13.1	-8344								
47.000	659.681	1.516	1072.1	-113.75	-420	331.8	13.0	-8500								
48.000	679.657	1.471	1065.4	-114.03	-419	332.2	12.9	-8652								
49.000	698.867	1.428	1058.9	-114.31	-418	332.6	12.8	-8807								
50.000	720.233	1.387	1053.6	-114.58	-417	333.0	12.7	-8953								
8.039	68.046	14.694	1714.4	-84.95	-474	291.7	23.6	1.608	291.7	298.0	312.5	315.3	1.605	1.731		

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. G/O
 DEG K GM/CC (KCAL/FORM.WT.)
 298 N2O4 1.43 -5.4 64.
 298 N2H4 1.004 +12.05 36.

BULK DENSITY = 1.241 GM/CC
 MIXTURE RATIO = 1.778 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 267.97 EU/100GMS

CHAMBER	FROZEN EXPANSION										THROAT		
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	557.9
TEMP, DEG K	3163.5	2673.4	2250.2	1883.9	1567.2	1402.9	1293.2	1057.1	855.2	684.8	543.3	427.9	2844.7
ENTHALPY (-)	-9.78	13.91	33.89	50.67	64.67	71.69	76.28	85.81	93.57	99.81	104.79	108.72	5.69
CP	.4885	.4779	.4653	.4502	.4329	.4219	.4135	.3938	.3746	.3582	.3455	.3370	.4819
IMPUL OPT	143.57	194.91	229.33	254.50	266.23	273.62	288.38	299.85	308.77	315.71	321.09	326.21	116.01
IMPUL VAC	215.11	239.26	260.49	278.16	286.48	291.78	302.46	310.81	317.29	322.32	326.21	326.21	210.22
EPSILON	1.064	1.657	2.962	5.577	8.157	10.752	20.948	40.941	79.969	155.853	303.179	1.000	

CHAMBER	SHIFTING EXPANSION										THROAT		
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	570.3
TEMP, DEG K	3163.5	2822.4	2486.1	2151.6	1829.2	1653.1	1533.3	1271.0	1042.6	846.2	679.7	540.8	2954.3
ENTHALPY (-)	-9.78	14.41	35.65	54.11	69.89	77.93	83.21	94.31	103.46	110.93	116.97	121.79	5.33
X BAR	4.444	4.392	4.358	4.341	4.335	4.334	4.333	4.333	4.333	4.333	4.333	4.333	4.410
N	4.444	4.392	4.358	4.341	4.335	4.334	4.333	4.333	4.333	4.333	4.333	4.333	4.410
CP	.8995	.7574	.6243	.5263	.4684	.4474	.4352	.4112	.3903	.3708	.3540	.3409	.8133
IMPUL OPT	145.06	198.81	235.76	263.28	276.24	284.43	300.92	313.88	324.06	332.06	338.32	344.31	114.66
IMPUL VAC	218.93	245.93	270.01	289.31	298.66	304.62	316.75	326.32	333.85	339.73	344.31	344.31	212.90
EPSILON	1.077	1.726	3.151	6.018	8.858	11.725	23.075	45.585	90.014	177.236	347.663	1.000	

COMPOSITION SHIFTING (MOL/100 GM)												
52.10 H	.0191	.0074	.0019	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0111
19.20 H2N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-10.00 H2O	.0100	.0057	.0030	.0013	.0005	.0002	.0001	.0000	.0000	.0000	.0000	.0072
4.33 H2O	.1760	.1088	.0553	.0209	.0054	.0020	.0009	.0001	.0000	.0000	.0000	.1337
.00 H2	.0873	.0434	.0159	.0037	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0587
40.30 H2N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2O	2.0568	2.1422	2.2006	2.2317	2.2437	2.2454	2.2461	2.2466	2.2466	2.2466	2.2466	2.1119
-11.04 H2N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
21.65 N2O	.0894	.0611	.0376	.0196	.0081	.0043	.0026	.0006	.0001	.0000	.0000	.0716
.00 N2	.0002	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
1.7690 1.7854	1.7690	1.7854	1.7986	1.8084	1.8145	1.8166	1.8175	1.8185	1.8188	1.8188	1.8188	1.7794
19.50 N2O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.0226	.0113	.0042	.0010	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0152
.00 O2	.2135	.2264	.2407	.2538	.2674	.2651	.2662	.2674	.2677	.2677	.2677	.2212

PRESSURE PROFILE DATA
 SYSTEM LIQUID HYDROFILLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 298 H₂O 1.43 -5.4 40.
 298 H₂ 1.004 +12.05 60.

BULK DENSITY = 1.140 GM/CC
 MIXTURE RATIO = .667 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 331.05 EU/100GMS

CHAMBER													THROAT
	FROZEN EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	165.8
TEMP, DEG K	2552.2	2168.2	1833.2	1541.0	1342.7	1286.6	1066.1	876.7	715.8	580.9	469.0	377.9	2262.9
ENTHALPY (-)	-20.21	2.52	21.80	38.05	48.71	51.66	62.99	72.34	80.01	86.75	91.30	95.36	-3.02
CP	.5997	.5840	.5656	.5459	.5292	.5240	.5035	.4844	.4684	.4562	.4481	.4427	.5880
IMPUL 3PT	140.64	191.17	225.13	244.87	250.06	269.04	283.76	295.28	304.33	311.47	317.09	322.79	
IMPUL VAC	221.49	241.46	261.03	273.67	277.04	289.82	299.96	307.99	314.34	319.37	323.34	329.33	
EPSILON	1.025	1.420	2.258	3.343	3.780	6.483	11.256	19.669	34.485	60.591	106.782	1.000	
	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.47	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	165.9
TEMP, DEG K	2552.2	2188.9	1857.0	1563.2	1363.0	1306.4	1083.6	892.0	729.0	592.2	479.7	394.2	2280.9
ENTHALPY (-)	-20.21	2.62	22.04	38.51	49.30	52.79	63.77	73.26	81.04	87.38	92.52	96.69	-2.98
X BAR	6.066	6.055	6.052	6.051	6.051	6.051	6.051	6.051	6.051	6.050	6.045	6.015	6.056
N	6.066	6.055	6.052	6.051	6.051	6.051	6.051	6.051	6.051	6.050	6.045	6.015	6.056
CP	.6759	.6078	.5716	.5479	.5307	.5256	.5049	.4857	.4697	.4590	.4661	.5942	.6213
IMPUL OPT	140.94	191.81	226.02	245.92	251.15	270.31	285.16	296.80	305.95	313.17	318.91	322.44	
IMPUL VAC	222.23	242.46	262.20	274.91	278.37	291.28	301.53	309.65	316.07	321.18	325.33	329.98	
EPSILON	1.026	1.424	2.266	3.356	3.795	6.513	11.316	19.788	34.726	61.152	109.326	1.000	
	COMPOSITION SHIFTING (MOL/100 GM)												
52.10 H	.0241	.0061	.0010	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0090
79.20 H ₂	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-10.00 H ₂ O	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
9.33 H ₂ O	.0044	.0007	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0013
.00 H ₂	1.9963	2.0028	2.0050	2.0054	2.0055	2.0055	2.0054	2.0053	2.0050	2.0038	1.9968	1.9508	2.0017
40.30 H ₂ N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H ₂ O	1.7333	1.7380	1.7388	1.7388	1.7388	1.7388	1.7388	1.7388	1.7388	1.7388	1.7388	1.7388	1.7374
-11.04 H ₂ N	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0003	.0012	.0058	.0365	.0001
113.00 N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
21.65 N ₂ O	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
8.06 N ₂ O ₂	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N ₂	2.3065	2.3068	2.3069	2.3069	2.3069	2.3069	2.3069	2.3068	2.3067	2.3063	2.3040	2.2886	2.3068
19.50 N ₂ O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 O ₂	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

SYSTEM LIQUID BIPROPELLANT										PC 300. PSIA		HEAT FORM		WT. O/D	
COMPONENT										DENSITY		(KCAL/FORM.WT.)			
										UM/CC		5.4		60.	
										1.43		+12.05			
										1.004					
										FROZEN EXPANSION					
										C STAR = 5649.1 FT/SEC					
										DEL VAC					
										DEL VAC					
										I SEA					
										I AT					
										I AT					
										I VAC					
										CF SEA					
										CF VAC					
												</			

PRESSURE PROFILE DATA
 SYSTEM LIQUID HIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 298 N2*O4 1.43 -5.4 48.
 298 N2*H4 1.004 +12.05 52.

PULK DENSITY = 1.172 GM/CC
 MIXTURE RATIO = .923 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 315.75 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	167.0
TEMP, DEG K	2915.2	2498.9	2133.8	1913.8	1595.1	1533.0	1287.2	1072.7	887.0	727.8	593.3	480.9	2605.1
ENTHALPY (-)	-16.73	6.68	26.72	43.79	55.11	58.27	70.46	80.67	89.14	96.12	101.82	106.47	.75
CP	.5683	.5562	.5416	.5245	.5105	.5060	.4854	.4657	.4467	.4305	.4177	.4088	.5595
IMPUL OPT		142.72	194.43	229.47	250.01	255.44	275.43	291.09	303.49	313.33	321.16	327.39	123.35
IMPUL VAC		225.16	246.11	266.69	280.05	283.70	297.43	308.45	317.25	324.27	329.86	334.30	222.79
EPSILON		1.028	1.434	2.300	3.432	3.890	6.745	11.845	20.920	37.029	65.577	116.122	1.000
	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	168.3
TEMP, DEG K	2915.2	2574.4	2234.6	1913.8	1689.0	1624.9	1369.8	1146.3	951.9	784.3	641.6	521.9	2669.5
ENTHALPY (-)	-16.73	6.97	27.62	45.40	57.24	60.55	73.36	84.13	93.11	100.53	106.63	111.60	.70
X BAR	5.446	5.410	5.395	5.390	5.390	5.389	5.389	5.389	5.389	5.389	5.389	5.389	5.418
N	5.446	5.410	5.395	5.390	5.390	5.389	5.389	5.389	5.389	5.389	5.389	5.389	5.418
CP	.6341	.6760	.5828	.5378	.5180	.5128	.4918	.4714	.4516	.4346	.4207	.4111	.7133
IMPUL OPT		143.59	196.44	232.50	253.69	259.29	279.97	296.22	309.13	319.40	327.60	334.14	123.17
IMPUL VAC		227.45	249.49	270.86	284.71	288.49	302.76	314.25	323.47	330.84	336.73	341.42	224.69
EPSILON		1.032	1.454	2.340	3.498	3.967	6.898	12.149	21.529	38.234	67.912	120.594	1.000
	COMPOSITION SHIFTING (MOL/100 GM)												
52.10 H	.0667	.0284	.0084	.0016	.0003	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0372
79.20 H*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-10.00 H*H*O	.0015	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0007
9.33 H*O	.0381	.0119	.0023	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0172
.00 H2	1.1531	1.1521	1.1557	1.1579	1.1584	1.1584	1.1585	1.1585	1.1585	1.1585	1.1584	1.1579	1.1515
40.30 H2*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2*O	2.0388	2.0726	2.0840	2.0863	2.0866	2.0866	2.0866	2.0866	2.0866	2.0866	2.0866	2.0866	2.0660
-11.04 H3*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	.0004	.0000
113.00 N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
21.65 N*O	.0049	.0011	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0018
8.06 N*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	2.1410	2.1434	2.1441	2.1442	2.1442	2.1442	2.1442	2.1442	2.1442	2.1442	2.1442	2.1440	2.1429
19.50 N2*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.0013	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
.00 O2	.0010	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003

SYSTEM LIQUID DIPROPELLANT										PC 100, PSIA		DENSITY		HEAT FORM		WT. 0/0	
COMPONENT										REF. FORMULA		GM/CC		(KCAL/FORM.WT.)			
										DEG K		1.43		-5.4		48.	
										298 N2H4		1.004		+12.05		52.	
										FROZEN EXPANSION							
										C STAR + 5748.9 FT/SEC							
										DEL VAC		DEL VAC		DEL VAC		DEL VAC	
										I SEA		I AT		I AT		I VAC	
										LVL		10000		50000		CF SEA	
										LVL		LVL		LVL		LVL	
EPSILON	PC/F	P PSIA	TEMP	ENTHALPY	CP CAL/	1 OPT	DEL VAC	DEL VAC	DEL VAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC	CF VAC	CF VAC
			DEG K	KCAL/100GM	GM DEG												
1.000	1.000	300.000	2915.2	16.73	.568												
2.000	1.957	166.646	2605.1	-16.75	.559		221.9	39.4	.596	214.0	216.7	221.8	222.8	1.198	1.241		
3.000	9.491	31.947	1833.9	-39.58	.529	221.9	39.5	1.737	243.7	248.7	259.3	261.4	1.361	1.463			
4.000	16.753	17.407	1864.8	-51.54	.515	243.7	32.1	1.795	249.5	257.4	272.8	275.9	1.396	1.544			
5.000	25.643	11.699	1519.2	-55.95	.505	256.6	27.9	2.183		260.0	280.4	284.5			1.592		
6.000	35.751	8.191	1415.7	-64.15	.497	265.3	25.1	2.993			285.3	290.4			1.625		
7.000	46.539	6.446	1316.1	-68.08	.490	271.6	23.2	3.592			288.7	294.8			1.650		
8.000	57.888	5.183	1272.0	-71.77	.484	276.6	21.7	4.178			291.1	298.2			1.669		
9.000	70.550	4.252	1218.6	-75.77	.479	280.6	20.4	4.807			292.9	301.1			1.685		
10.000	83.719	3.584	1171.1	-79.94	.475	284.0	19.4	5.426			294.2	303.4			1.698		
11.000	97.149	3.087	1131.7	-84.31	.471	286.8	18.6	6.023			295.1	305.4			1.709		
12.000	110.608	2.712	1094.0	-88.84	.468	289.3	17.9	6.594			295.9	307.1			1.719		
13.000	124.121	2.413	1068.1	-93.48	.465	291.4	17.3	7.152			296.5	308.7			1.727		
14.000	137.759	2.171	1043.3	-98.17	.462	293.3	16.7	7.778			296.8	310.0			1.735		
15.000	155.671	1.927	1015.1	-102.93	.460	295.1	16.2	8.404			296.9	311.3			1.742		
16.000	171.953	1.745	992.0	-107.79	.458	296.6	15.7	9.024			297.0	312.4			1.748		
17.000	188.511	1.591	970.2	-112.75	.455	298.0	15.3	9.635			297.0	313.4			1.754		
18.000	205.259	1.462	951.4	-117.81	.453	299.3	15.0	10.237			297.0	314.3			1.759		
19.000	222.127	1.351	933.2	-122.96	.452	300.5	14.6	10.825			297.0	315.1			1.764		
20.000	239.080	1.259	916.4	-128.22	.450	301.6	14.3	11.400			297.0	315.9			1.768		
21.000	256.021	1.172	900.6	-133.58	.448	302.6	14.0	11.958			297.0	316.6			1.772		
22.000	273.144	1.098	885.8	-139.14	.447	303.6	13.7	12.510			297.0	317.3			1.776		
23.000	292.241	1.037	871.9	-144.81	.445	304.5	13.5	13.134			297.0	317.9			1.779		
24.000	311.692	.982	858.7	-150.59	.444	305.3	13.2	13.757			297.0	318.5			1.783		
25.000	331.689	.935	846.1	-156.45	.443	306.1	13.0	14.368			297.0	319.0			1.786		
26.000	351.982	.895	834.5	-162.41	.441	306.8	12.8	14.967			297.0	319.6			1.789		
27.000	371.934	.862	823.3	-168.46	.440	307.5	12.6	15.562			297.0	320.2			1.792		
28.000	392.554	.836	812.6	-174.63	.439	308.2	12.4	16.147			297.0	320.8			1.794		
29.000	413.849	.812	802.5	-180.92	.438	308.8	12.2	16.722			297.0	321.3			1.797		
30.000	435.815	.791	792.8	-187.33	.437	309.4	12.1	17.285			297.0	321.9			1.799		
31.000	458.227	.773	783.5	-193.79	.436	310.0	11.9	17.837			297.0	322.3			1.801		
32.000	476.369	.759	774.6	-200.30	.435	310.5	11.7	18.378			297.0	322.8			1.804		
33.000	495.568	.749	766.1	-206.86	.434	311.0	11.6	18.911			297.0	323.2			1.806		
34.000	514.862	.741	757.9	-213.47	.434	311.5	11.5	19.435			297.0	323.7			1.808		
35.000	534.140	.735	750.7	-220.13	.433	312.0	11.3	19.958			297.0	324.1			1.809		
36.000	551.524	.731	742.4	-226.84	.432	312.5	11.2	20.479			297.0	324.6			1.811		
37.000	568.662	.729	735.1	-233.60	.431	312.9	11.1	21.000			297.0	325.0			1.813		
38.000	586.269	.729	728.2	-240.41	.431	313.3	10.9	21.519			297.0	325.5			1.815		
39.000	604.117	.729	721.2	-247.26	.430	313.7	10.8	22.036			297.0	326.0			1.816		
40.000	622.084	.729	714.6	-254.14	.429	314.1	10.7	22.551			297.0	326.4			1.818		
41.000	640.117	.729	708.3	-261.06	.429	314.5	10.6	23.066			297.0	326.9			1.819		
42.000	658.269	.729	702.1	-268.02	.428	314.9	10.5	23.579			297.0	327.3			1.821		
43.000	676.494	.729	696.1	-275.02	.427	315.2	10.4	24.091			297.0	327.8			1.822		
44.000	694.855	.729	690.3	-282.06	.427	315.6	10.3	24.602			297.0	328.2			1.824		
45.000	713.334	.729	684.7	-289.14	.426	315.9	10.2	25.112			297.0	328.7			1.825		
46.000	731.919	.729	679.3	-296.26	.426	316.2	10.1	25.622			297.0	329.1			1.826		
47.000	750.597	.729	674.1	-303.41	.425	316.5	10.0	26.131			297.0	329.6			1.827		
48.000	769.362	.729	669.0	-310.60	.425	316.8	9.9	26.639			297.0	330.0			1.829		
49.000	788.217	.729	664.0	-317.83	.424	317.1	9.8	27.147			297.0	330.5			1.830		
50.000	807.155	.729	659.2	-325.10	.424	317.4	9.8	27.654			297.0	331.0			1.831		
51.000	826.179	.729	654.6	-332.41	.423	317.7	9.7	28.160			297.0	331.5			1.832		
52.000	845.284	.729	650.1	-339.76	.423	318.0	9.7	28.665			297.0	332.0			1.833		
53.000	864.379	.729	645.7	-347.14	.423	318.3	9.6	29.169			297.0	332.5			1.834		
54.000	883.459	.729	641.4	-354.56	.423	318.6	9.5	29.672			297.0	333.0			1.835		
55.000	902.519	.729	637.2	-362.02	.423	318.9	9.4	30.175			297.0	333.5			1.836		
56.000	921.559	.729	633.1	-369.52	.423	319.2	9.4	30.677			297.0	334.0			1.837		
57.000	940.579	.729	629.1	-377.06	.423	319.5	9.3	31.179			297.0	334.5			1.838		
58.000	959.579	.729	625.2	-384.64	.423	319.8	9.2	31.680			297.0	335.0			1.839		
59.000	978.559	.729	621.4	-392.26	.423	320.1	9.2	32.181			297.0	335.5			1.840		
60.000	997.519	.729	617.7	-399.92	.423	320.4	9.1	32.682			297.0	336.0			1.841		

PRESSURE PROFILE DATA
 SYSTEM LIQUID R/PROPELLANT PC 300. PSIA
 COMPONENT TRFF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 298 H2O4 1.43 -5.4 52.
 298 H2O4 1.004 +12.05 48.

BULK DENSITY = 1.188 GM/CC
 MIXTURE RATIO = 1.043 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 307.27 FU/100GMS

CHAMBER

THRUST

	FROZEN EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	166.9
TEMP, DEG K	3057.2	2627.6	2254.1	1924.1	1638.3	1634.1	1379.3	1155.8	961.1	792.9	649.3	528.4	2738.6
ENTHALPY (-)	-15.00	8.31	28.32	45.44	56.84	60.02	72.36	82.75	91.42	98.60	104.51	109.33	2.41
CP	.5502	.5192	.5261	.5108	.4979	.4937	.4746	.4548	.4353	.4184	.4043	.3934	.5423
IMPUL OPT	142.38	194.12	229.30	249.98	255.46	275.68	291.61	304.27	314.37	322.43	328.87	336.04	123.06
IMPUL VAC	224.76	245.91	266.73	280.29	283.99	297.99	309.29	318.36	325.62	331.42	336.04	342.32	
EPSILON	1.028	1.440	2.317	3.467	3.933	6.851	12.086	21.451	38.144	67.820	120.502	1.000	

	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	170.1
TEMP, DEG K	3057.2	2752.9	2435.4	2114.7	1880.6	1812.9	1541.7	1301.9	1091.2	907.5	748.8	613.5	2842.5
ENTHALPY (-)	-15.00	8.73	29.73	48.77	60.40	63.86	77.34	88.76	98.37	106.40	113.05	118.51	2.12
X BAR	5.159	5.105	5.074	5.062	5.059	5.059	5.058	5.058	5.058	5.058	5.058	5.058	5.118
N	5.159	5.105	5.074	5.062	5.059	5.059	5.058	5.058	5.058	5.058	5.058	5.058	5.118
CP	1.0181	.7981	.6330	.5470	.5152	.5087	.4862	.4660	.4464	.4270	.4107	.3977	.8588
IMPUL OPT	143.65	197.26	234.23	256.11	261.92	283.42	300.44	314.05	324.97	333.76	340.81	348.81	122.03
IMPUL VAC	228.22	251.42	273.74	288.23	292.19	307.21	319.39	329.24	337.19	343.57	348.68	355.09	
EPSILON	1.036	1.477	2.400	3.606	4.096	7.167	12.714	22.704	40.633	72.699	129.897	1.000	

	COMPOSITION SHIFTING (MOL/100 GM)												
52.10 H	.0823	.0443	.0178	.0048	.0013	.0008	.0001	.0000	.0000	.0000	.0000	.0000	.0543
79.20 H2O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-10.00 H2O	.0029	.0012	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0016
9.33 H2O	.0830	.0370	.0109	.0019	.0003	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0485
.00 H2	.7682	.7417	.7335	.7338	.7346	.7347	.7350	.7350	.7350	.7350	.7350	.7350	.7473
40.30 H2O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-7.80 H2O	2.1432	2.2125	2.2475	2.2584	2.2601	2.2603	2.2605	2.2605	2.2605	2.2605	2.2605	2.2605	2.1960
-11.04 H2O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
21.65 N2	.0142	.0051	.0011	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0072
8.06 N2O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	2.0543	2.0597	2.0621	2.0628	2.0629	2.0629	2.0629	2.0629	2.0629	2.0629	2.0629	2.0629	2.0585
19.50 N2O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.0053	.0014	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0021
.00 O2	.0059	.0017	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0026

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 298 N2*O4 1.43 -5.4 57.
 298 N2*H4 1.004 +12.05 43.

BULK DENSITY = 1.209 GM/CC
 MIXTURE RATIO = 1.326 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 295.91 EU/100GMS

CHAMBER													THROAT
FROZEN EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	166.7
TEMP, DEG K	3148.7	2715.6	2334.9	1999.6	1769.9	1704.4	1444.6	1215.9	1015.8	841.8	692.3	565.4	2825.5
ENTHALPY (-)	-12.82	9.72	29.13	45.79	56.91	60.02	72.12	82.35	90.92	98.06	103.95	108.78	4.04
CP	.5254	.5153	.5033	.4898	.4779	.4741	.4563	.4374	.4189	.4015	.3865	.3747	.5180
IMPUL OPT		140.04	191.04	225.81	246.30	251.74	271.85	287.74	300.42	310.58	318.73	325.25	121.13
IMPUL VAC		221.16	242.17	262.86	276.36	280.07	294.08	305.42	314.57	321.92	327.81	332.52	218.71
EPSILON		1.029	1.444	2.330	3.494	3.967	6.933	12.279	21.879	39.057	69.702	124.220	1.000
SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	172.8
TEMP, DEG K	3148.7	2892.4	2635.7	2375.3	2156.6	2088.6	1802.7	1541.2	1308.5	1102.9	922.2	765.0	2971.2
ENTHALPY (-)	-12.82	10.25	31.09	49.79	62.68	66.34	80.71	93.05	103.56	112.46	119.52	126.15	3.32
X BAR	4.839	4.765	4.706	4.666	4.651	4.649	4.645	4.645	4.645	4.645	4.645	4.645	4.787
N	4.839	4.765	4.706	4.666	4.651	4.649	4.645	4.645	4.645	4.645	4.645	4.645	4.787
CP	1.2769	1.1092	.9038	.6832	.5603	.5368	.4844	.4613	.4420	.4229	.4038	.3871	1.1650
IMPUL OPT		141.68	195.46	233.40	256.30	262.43	285.25	303.49	318.20	330.13	339.83	347.71	118.50
IMPUL VAC		225.79	250.41	274.45	290.13	294.42	310.63	323.88	334.71	343.55	350.73	356.54	222.27
EPSILON		1.040	1.513	2.517	3.835	4.368	7.718	13.810	24.903	45.053	81.504	147.149	1.000
COMPOSITION SHIFTING (MOL/100 GM)													
52.10 H	.0737	.0455	.0245	.0105	.0043	.0031	.0006	.0001	.0000	.0000	.0000	.0000	.0535
79.20 H*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-10.00 H*N*O	.0051	.0029	.0015	.0006	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0035
9.33 H*O	.1596	.1032	.0559	.0214	.0069	.0045	.0005	.0000	.0000	.0000	.0000	.0000	.1199
.00 H2	.3886	.3200	.2613	.2218	.2090	.2075	.2056	.2056	.2056	.2056	.2056	.2056	.3405
40.30 H2*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2*O	2.1756	2.2877	2.3812	2.4454	2.4688	2.4721	2.4773	2.4778	2.4778	2.4778	2.4778	2.4778	2.2545
-11.04 H3*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
21.65 N*O	.0398	.0236	.0114	.0036	.0009	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0282
8.06 N*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	1.9387	1.9479	1.9548	1.9591	1.9606	1.9609	1.9612	1.9612	1.9612	1.9612	1.9612	1.9612	1.9453
19.50 N2*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.0178	.0089	.0033	.0007	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0113
.00 O2	.0359	.0257	.0123	.0031	.0005	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0302

SYSTEM LIQUID BIPROPELLANT										PC 300. PSIA									
COMPONENT										DENSITY									
REF. FORMULA										HEAT FORM									
DEG K										(KCAL/FORM.WT.)									
298 N2=04										1.43									
298 N2=444										1.004									
FROZEN EXPANSION										+12.05									
C STAR = 5650.4 FT/SEC										43.									
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I NPT	DELTA	DELTA	DELTA	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC				
			DEG K	KCAL/100GM	GM DEG					LVL	10000	50000		LVL					
1.000	1.000	100.000	1848.7	12.87	525														
1.000	1.000	100.000	2025.5	-4.04	518	171.1	91.6	585	210.1	212.7	217.7	218.7	1.136	1.245					
2.000	9.242	32.462	2090.8	-41.32	494	217.6	34.5	1.218	234.2	244.6	255.0	257.1	1.362	1.464					
3.000	16.359	18.338	1852.1	-52.96	482	239.3	32.4	1.764	245.7	251.5	268.6	271.6	1.399	1.547					
4.000	24.499	12.049	1700.2	-60.72	474	252.1	28.2	2.362		256.3	276.3	280.3		1.596					
5.000	34.753	8.677	1531.5	-65.34	467	260.8	24.5	3.041			281.3	286.3		1.630					
6.000	44.856	6.682	1507.8	-69.22	461	267.2	23.6	3.532			284.7	290.8		1.656					
7.000	55.548	5.401	1440.4	-72.31	456	272.1	22.1	4.103			287.3	294.3		1.676					
8.000	67.546	4.441	1384.1	-74.87	452	276.2	21.0	4.718			289.1	297.2		1.692					
9.000	80.314	3.744	1335.9	-77.03	448	279.6	20.0	5.340			290.5	299.4		1.708					
10.000	92.762	3.233	1294.2	-78.90	444	282.5	19.2	5.925			291.5	301.6		1.718					
11.000	105.014	2.841	1257.4	-80.53	441	285.0	18.5	6.496			292.4	303.4		1.728					
12.000	118.419	2.533	1224.5	-81.97	438	287.2	17.8	7.041			293.0	305.0		1.737					
13.000	132.439	2.265	1194.8	-83.27	436	289.1	17.3	7.531			293.4	306.4		1.745					
14.000	147.326	2.036	1167.9	-84.44	433	290.9	16.8	8.047			293.6	307.7		1.752					
15.000	162.575	1.845	1143.3	-85.50	431	292.5	16.3	8.580			293.7	308.8		1.759					
16.000	178.103	1.684	1120.6	-86.48	429	293.9	15.9	9.107			309.9			1.764					
17.000	193.832	1.548	1099.7	-87.37	427	295.2	15.6	9.625			310.8			1.770					
18.000	209.853	1.431	1080.2	-88.10	425	296.5	15.2	10.135			311.7			1.775					
19.000	226.032	1.332	1062.0	-88.69	423	297.6	14.9	10.627			312.5			1.780					
20.000	241.667	1.242	1045.0	-89.69	422	298.6	14.6	11.104			313.3			1.784					
21.000	257.552	1.165	1029.1	-90.77	420	299.6	14.4	11.569			314.3			1.788					
22.000	273.786	1.105	1014.0	-91.77	419	300.5	14.1	12.082			314.6			1.792					
23.000	291.758	1.058	999.8	-92.94	417	301.4	13.9	12.544			315.1			1.795					
24.000	310.343	1.028	986.3	-93.15	416	302.2	13.7	12.979			315.9			1.799					
25.000	328.621	1.013	973.5	-93.44	415	303.0	13.6	13.421			316.4			1.802					
26.000	347.455	1.001	961.3	-93.79	414	303.7	13.2	13.855			316.9			1.805					
27.000	366.715	0.991	949.7	-94.17	412	304.4	13.1	14.284			317.4			1.807					
28.000	386.769	0.984	938.6	-94.53	411	305.0	12.9	14.691			317.9			1.810					
29.000	406.189	0.979	928.0	-94.86	410	305.7	12.7	15.075			318.3			1.813					
30.000	424.748	0.976	917.9	-95.17	409	306.2	12.5	15.455			318.8			1.815					
31.000	444.420	0.975	908.1	-95.47	408	306.8	12.4	15.824			319.2			1.817					
32.000	464.189	0.976	898.8	-95.75	407	307.3	12.2	16.192			319.6			1.820					
33.000	484.019	0.979	889.8	-96.02	406	307.9	12.1	16.555			320.0			1.822					
34.000	503.968	0.985	881.1	-96.27	406	308.4	12.0	16.917			320.4			1.824					
35.000	523.837	0.993	872.8	-96.51	405	308.8	11.8	17.284			320.7			1.826					
36.000	543.754	0.998	864.8	-96.71	404	309.3	11.7	17.649			321.0			1.828					
37.000	563.732	0.998	857.0	-96.85	403	309.7	11.6	18.015			321.3			1.830					
38.000	583.764	0.998	849.5	-96.95	402	310.2	11.5	18.379			321.6			1.831					
39.000	603.770	0.997	842.2	-97.04	402	310.6	11.3	18.733			321.9			1.833					
40.000	623.860	0.997	835.2	-97.12	401	311.0	11.2	19.087			322.2			1.835					
41.000	643.910	0.997	828.4	-97.19	400	311.3	11.1	19.441			322.5			1.836					
42.000	663.937	0.997	821.8	-97.26	399	311.7	11.0	19.795			322.7			1.838					
43.000	683.978	0.997	815.4	-97.31	399	312.1	10.9	20.149			323.0			1.839					
44.000	703.977	0.997	809.1	-97.36	398	312.4	10.8	20.503			323.2			1.841					
45.000	723.956	0.997	803.1	-97.40	398	312.7	10.7	20.857			323.4			1.842					
46.000	743.910	0.997	797.2	-97.44	397	313.1	10.7	21.211			323.7			1.843					
47.000	763.845	0.997	791.5	-97.48	396	313.4	10.6	21.565			323.9			1.845					
48.000	783.765	0.997	785.9	-97.52	396	313.7	10.5	21.919			324.2			1.846					
49.000	803.665	0.997	780.5	-97.55	395	314.0	10.4	22.273			324.4			1.847					
50.000	823.547	0.997	775.2	-97.57	395	314.3	10.3	22.627			324.6			1.848					
3.444	20.414	14.636	1763.4	-56.31	478	246.3	30.1	2.046	246.3	255.4	272.4	276.4	1.422	1.574					

SHIFTING EXPANSION														
C STAR = 5795.1 FT/SEC														
COMP	PCW	W POS	TEMP	ENTHAL	OP CAL	1 TPT	DELTA	DELTA	1 SEA	1	I AT	1	SEA	
			DEG K	KCAL/100GM	CELS				LVL	10000	56000	LVL		
1.000	1.500	900.000	316.2	1.511	1.511	1.511	1.511	1.511	213.4	216.1	221.2	222.3	1.234	1.185
2.000	1.736	172.455	2471.2	-1.332	1.165	118.5	103.8	6.200	213.4	216.1	221.2	222.3	1.234	1.185
3.000	8.241	35.182	2489.2	-42.24	.774	219.1	45.2	1.240	254.8	262.8	276.5	277.1	1.367	1.409
4.000	14.365	24.855	2284.3	-55.33	.624	264.3	37.7	1.809	254.8	262.8	276.5	277.1	1.415	1.562
5.000	21.667	15.810	2114.6	-63.88	.552	258.3	33.2	2.402	254.8	262.8	276.5	277.1	1.513	1.671
6.000	29.000	10.424	2014.9	-69.58	.482	250.9	29.2	3.009	254.8	262.8	276.5	277.1	1.608	1.750
7.000	36.758	7.740	1926.4	-74.86	.400	255.9	26.0	3.622	254.8	262.8	276.5	277.1	1.687	1.814
8.000	44.214	6.245	1850.1	-78.42	.349	281.7	26.4	4.227	254.8	262.8	276.5	277.1	1.711	1.750
9.000	51.666	5.101	1785.6	-81.53	.312	286.5	25.0	4.812	254.8	262.8	276.5	277.1	1.730	1.750
10.000	58.315	4.191	1707.4	-84.18	.281	291.2	23.4	5.381	254.8	262.8	276.5	277.1	1.750	1.750
11.000	64.100	3.491	1627.4	-86.48	.252	295.9	21.0	5.934	254.8	262.8	276.5	277.1	1.750	1.750
12.000	70.465	2.916	1533.7	-88.48	.226	296.3	22.2	6.465	254.8	262.8	276.5	277.1	1.750	1.750
13.000	76.765	2.450	1437.5	-90.26	.202	296.5	21.5	7.277	254.8	262.8	276.5	277.1	1.750	1.750
14.000	82.928	2.057	1356.9	-91.87	.183	301.8	20.8	7.847	254.8	262.8	276.5	277.1	1.750	1.750
15.000	88.945	1.734	1275.5	-93.31	.164	301.8	20.3	8.344	254.8	262.8	276.5	277.1	1.750	1.750
16.000	94.815	1.475	1194.5	-94.64	.148	305.5	19.8	9.042	254.8	262.8	276.5	277.1	1.750	1.750
17.000	100.549	1.268	1108.2	-95.85	.136	307.1	19.3	9.573	254.8	262.8	276.5	277.1	1.750	1.750
18.000	106.146	1.036	1025.7	-96.97	.126	309.5	18.9	10.301	254.8	262.8	276.5	277.1	1.750	1.750
19.000	111.610	.841	947.2	-98.00	.118	311.6	18.4	11.000	254.8	262.8	276.5	277.1	1.750	1.750
20.000	116.950	.675	871.9	-98.97	.111	313.9	18.2	11.539	254.8	262.8	276.5	277.1	1.750	1.750
21.000	122.172	.538	799.1	-99.87	.104	315.1	17.8	12.145	254.8	262.8	276.5	277.1	1.750	1.750
22.000	127.279	.426	729.5	-100.71	.097	316.4	17.5	12.740	254.8	262.8	276.5	277.1	1.750	1.750
23.000	132.262	.334	663.2	-101.50	.090	317.6	17.2	13.323	254.8	262.8	276.5	277.1	1.750	1.750
24.000	137.115	.259	600.2	-102.25	.083	318.6	16.9	13.894	254.8	262.8	276.5	277.1	1.750	1.750
25.000	141.846	.197	541.2	-102.96	.076	319.4	16.7	14.455	254.8	262.8	276.5	277.1	1.750	1.750
26.000	146.455	.146	486.0	-103.63	.070	320.1	16.5	15.012	254.8	262.8	276.5	277.1	1.750	1.750
27.000	150.940	.104	434.2	-104.26	.064	321.2	16.3	15.561	254.8	262.8	276.5	277.1	1.750	1.750
28.000	155.311	.076	384.8	-104.87	.059	322.1	16.0	16.100	254.8	262.8	276.5	277.1	1.750	1.750
29.000	159.578	.057	336.7	-105.45	.054	322.5	15.8	16.600	254.8	262.8	276.5	277.1	1.750	1.750
30.000	163.742	.043	290.5	-106.02	.049	322.5	15.6	17.029	254.8	262.8	276.5	277.1	1.750	1.750
31.000	167.804	.032	246.1	-106.52	.044	322.5	15.4	17.456	254.8	262.8	276.5	277.1	1.750	1.750
32.000	171.765	.024	203.4	-107.03	.040	322.9	15.3	17.881	254.8	262.8	276.5	277.1	1.750	1.750
33.000	175.627	.018	162.8	-107.51	.036	323.1	15.1	18.300	254.8	262.8	276.5	277.1	1.750	1.750
34.000	179.389	.013	124.1	-107.98	.033	324.2	15.0	20.021	254.8	262.8	276.5	277.1	1.750	1.750
35.000	183.051	.009	87.1	-108.43	.032	324.8	14.8	20.634	254.8	262.8	276.5	277.1	1.750	1.750
36.000	186.613	.006	50.0	-108.86	.031	325.4	14.6	21.244	254.8	262.8	276.5	277.1	1.750	1.750
37.000	190.075	.004	14.6	-109.27	.030	326.1	14.5	21.848	254.8	262.8	276.5	277.1	1.750	1.750
38.000	193.437	.003	0.0	-109.67	.029	326.4	14.4	22.444	254.8	262.8	276.5	277.1	1.750	1.750
39.000	196.699	.002	0.0	-110.06	.028	327.2	14.2	23.039	254.8	262.8	276.5	277.1	1.750	1.750
40.000	199.861	.001	0.0	-110.43	.028	327.1	14.1	23.626	254.8	262.8	276.5	277.1	1.750	1.750
41.000	202.923	.001	0.0	-110.79	.027	327.9	14.0	24.203	254.8	262.8	276.5	277.1	1.750	1.750
42.000	205.895	.001	0.0	-111.14	.026	328.1	13.9	24.781	254.8	262.8	276.5	277.1	1.750	1.750
43.000	208.777	.001	0.0	-111.48	.025	328.9	13.7	25.350	254.8	262.8	276.5	277.1	1.750	1.750
44.000	211.569	.001	0.0	-111.81	.024	329.3	13.6	25.912	254.8	262.8	276.5	277.1	1.750	1.750
45.000	214.281	.001	0.0	-112.13	.024	329.7	13.5	26.460	254.8	262.8	276.5	277.1	1.750	1.750
46.000	216.913	.001	0.0	-112.45	.023	330.1	13.4	27.015	254.8	262.8	276.5	277.1	1.750	1.750
47.000	219.465	.001	0.0	-112.74	.022	330.3	13.3	27.643	254.8	262.8	276.5	277.1	1.750	1.750
48.000	221.937	.001	0.0	-113.03	.021	330.9	13.2	28.271	254.8	262.8	276.5	277.1	1.750	1.750
49.000	224.329	.001	0.0	-113.32	.021	331.3	13.1	28.899	254.8	262.8	276.5	277.1	1.750	1.750
50.000	226.641	.001	0.0	-113.60	.020	331.6	13.0	29.528	254.8	262.8	276.5	277.1	1.750	1.750
51.000	228.873	.001	0.0	-113.88	.019	331.8	12.9	30.156	254.8	262.8	276.5	277.1	1.750	1.750
52.000	231.025	.001	0.0	-114.16	.018	332.0	12.8	30.784	254.8	262.8	276.5	277.1	1.750	1.750
53.000	233.197	.001	0.0	-114.44	.018	332.0	12.7	31.412	254.8	262.8	276.5	277.1	1.750	1.750
54.000	235.289	.001	0.0	-114.72	.017	332.0	12.6	32.040	254.8	262.8	276.5	277.1	1.750	1.750
55.000	237.301	.001	0.0	-115.00	.016	332.0	12.5	32.668	254.8	262.8	276.5	277.1	1.750	1.750
56.000	239.233	.001	0.0	-115.28	.015	332.0	12.4	33.296	254.8	262.8	276.5	277.1	1.750	1.750
57.000	241.185	.001	0.0	-115.56	.014	332.0	12.3	33.924	254.8	262.8	276.5	277.1	1.750	1.750
58.000	243.057	.001	0.0	-115.84	.013	332.0	12.2	34.552	254.8	262.8	276.5	277.1	1.750	1.750
59.000	244.849	.001	0.0	-116.12	.012	332.0	12.1	35.180	254.8	262.8	276.5	277.1	1.750	1.750
60.000	246.561	.001	0.0	-116.40	.011	332.0	12.0	35.808	254.8	262.8	276.5	277.1	1.750	1.750
61.000	248.193	.001	0.0	-116.68	.010	332.0	11.9	36.436	254.8	262.8	276.5	277.1	1.750	1.750
62.000	249.745	.001	0.0	-116.96	.009	332.0	11.8	37.064	254.8	262.8	276.5	277.1	1.750	1.750
63.000	251.217	.001	0.0	-117.24	.008	332.0	11.7	37.692	254.8	262.8	276.5	277.1	1.750	1.750
64.000	252.609	.001	0.0	-117.52	.007	332.0	11.6	38.320	254.8	262.8	276.5	277.1	1.750	1.750
65.000	253.921	.001	0.0	-117.80	.006	332.0	11.5	38.948	254.8	262.8	276.5	277.1	1.750	1.750
66.000	255.153	.001	0.0	-118.08	.005	332.0	11.4	39.576	254.8	262.8	276.5	277.1	1.750	1.750
67.000	256.305	.001	0.0	-118.36	.004	332.0	11.3	40.204	254.8	262.8	276.5	277.1	1.750	1.750
68.000	257.377	.001	0.0	-118.64	.003	332.0	11.2	40.832	254.8	262.8	276.5	277.1	1.750	1.750
69.000	258.369	.001	0.0	-118.92	.002	332.0	11.1	41.460	254.8	262.8	276.5	277.1	1.750	1.750
70.000	259.281	.001	0.0	-119.20	.001	332.0	11.0	42.088	254.8	262.8	276.5	277.1	1.750	1.750
71.000	260.113	.001	0.0	-119.48	.000	332.0	10.9	42.716	254.8	262.8	276.5	277.1	1.750	1.750
72.000	260.865	.001	0.0	-119.76	.000	332.0	10.8	43.344	254.8	262.8	276.5	277.1	1.750	1.750
73.000	261.537	.001	0.0	-120.04	.000	332.0	10.7	43.972	254.8	262.8	276.5	277.1	1.750	1.750
74.000	262.129	.001	0.0	-120.32	.000	332.0	10.6	44.600	254.8	262.8	276.5	277.1	1.750	1.750
75.000	262.641	.001	0.0	-120.60	.000	332.0	10.5	45.228	254.8	262.8	276.5	277.1	1.750	1.750
76.000	263.073	.001	0.0	-120.88	.000	332.0	10.4	45.856	254.8	262.8	276.5	277.1	1.750	1.750
77.000	263.425	.001	0.0	-121.16	.000	332.0	10.3	46.484	254.8	262.8	276.5	277.1	1.750	1.750
78.000	263.697	.001	0.0	-121.44	.000	332.0	10.2	47.112	254.8	262.8	276.5	277.1	1.750	1.750
79.000	263.889	.001	0.0	-121.72	.000	332.0	10.1	47.740	254.8	262.8	276.5	277.1	1.750	1.750
80.000	264.001	.001	0.0	-122.00	.000	332.0								

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 298 N2*O4 1.43 -5.4 64.
 298 N2*H4 1.004 +12.05 36.

BULK DENSITY = 1.241 GM/CC
 MIXTURE RATIO = 1.778 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 278.64 EU/100GMS

	CHAMBER										THROAT															
	FROZEN EXPANSION																									
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	167.8													
TEMP, DEG K	3077.3	2654.6	2282.8	1955.3	1730.9	1667.0	1413.1	1189.8	994.4	824.5	678.4	554.3	2765.2													
ENTHALPY (-)	-9.78	10.62	28.18	43.27	53.33	56.15	67.11	76.37	84.14	90.61	95.95	100.33	5.32													
CP	.4869	.4776	.4666	.4539	.4430	.4394	.4232	.4060	.3885	.3727	.3588	.3477	.4803													
IMPUL OPT	133.21	181.73	214.82	234.32	239.50	258.63	273.76	285.84	295.52	303.28	309.51	314.60														
IMPUL VAC	210.39	230.38	250.07	262.93	266.46	279.79	290.60	299.32	306.33	311.95	316.44	308.05														
EPSILON	1.029	1.444	2.330	3.496	3.968	6.938	12.289	21.906	39.124	69.851	124.544	1.000														
	SHIFTING EXPANSION																									
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	171.4													
TEMP, DEG K	3077.3	2811.6	2547.1	2276.9	2065.8	2001.8	1733.4	1484.1	1259.6	1060.6	885.9	734.0	2891.0													
ENTHALPY (-)	-9.78	11.06	29.93	46.58	58.11	61.37	74.25	85.33	94.77	102.76	109.45	115.03	5.02													
X BAR	4.480	4.423	4.380	4.352	4.341	4.339	4.335	4.333	4.333	4.333	4.333	4.333	4.438													
N	4.480	4.423	4.380	4.352	4.341	4.339	4.335	4.333	4.333	4.333	4.333	4.333	4.438													
CP	1.0527	.8479	.7393	.6040	.5294	.5121	.4609	.4315	.4103	.3919	.3746	.3592	.9457													
IMPUL OPT	134.66	185.63	221.43	243.02	248.80	270.38	287.65	301.60	312.90	322.07	329.51	313.47														
IMPUL VAC	214.49	237.58	260.12	274.92	278.98	294.40	306.98	317.24	325.60	332.38	337.86	211.23														
EPSILON	1.039	1.506	2.497	3.806	4.338	7.630	13.779	24.838	44.891	81.123	146.310	1.000														
	COMPOSITION SHIFTING (MOL/100 GM)																									
52.10 F	.0317	.0156	.0059	.0015	.0003	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0197													
79.20 H*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000													
-10.00 H*N	.0068	.0043	.0025	.0013	.0008	.0006	.0002	.0001	.0000	.0000	.0000	.0000	.0049													
9.33 H*O	.2008	.1384	.0842	.0422	.0207	.0161	.0044	.0008	.0001	.0000	.0000	.0000	.1564													
.00 F2	.1165	.0697	.0342	.0124	.0043	.0029	.0004	.0000	.0000	.0000	.0000	.0000	.0828													
40.30 F2*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000													
-57.80 H2*O	2.0105	2.0978	2.1662	2.2118	2.2315	2.2352	2.2439	2.2462	2.2466	2.2466	2.2466	2.2466	2.0733													
-11.04 H3*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000													
113.00 N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000													
21.65 N*O	.0833	.0608	.0416	.0256	.0159	.0135	.0059	.0020	.0006	.0001	.0000	.0000	.0672													
8.06 N*O2	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001													
.00 N2	1.7737	1.7862	1.7968	1.8054	1.8105	1.8118	1.8158	1.8178	1.8186	1.8188	1.8188	1.8188	1.7827													
19.50 N2*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000													
59.56 O	.0323	.0188	.0091	.0033	.0011	.0008	.0001	.0000	.0000	.0000	.0000	.0000	.0225													
.00 O2	.2241	.2309	.2393	.2490	.2561	.2579	.2638	.2665	.2674	.2677	.2677	.2677	.2288													

SYSTEM LIQUID BIPROPELLANT										PC 300. PSIA		DENSITY		HEAT FORM		WT. O/D	
COMPONENT										REF FORMULA		GM/CC		(KCAL/FORM.WT.)		84.	
										DEG K		1.43		5.4		84.	
										298 N2O4		1.004		412.05		36.	
										298 N2H4							
										FROZEN EXPANSION							
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OF₂ - B₂H₆ SYSTEM

PRESSURE PROFILE DATA
 SYSTEM C-F2-B2H6 PC 1000 PSIA PE 0.1 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 CEG K GM/CC (KCAL/FORM.WT.)
 OF2 128 O*F2 1.54 3.5 66.0
 B2H6 180 R2*H6 0.445 2.50 34.0

BULK DENSITY = .836 GM/CC
 MIXTURE RATIO = 1.941 LP OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTRCOPY 351.48 EU/100GMS

CHAMBER

THROAT

	FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	550.1
MP, DEG K	3663.6	3037.4	2508.7	2063.3	1688.5	1498.7	1374.0	1110.9	892.8	713.1	566.0	446.5	3245.3
ENTHALPY (-)	-7.35	31.72	64.06	90.72	112.60	123.43	130.45	144.93	156.60	165.96	173.41	179.31	18.84
X BAR	.6300	.6173	.6052	.5911	.5754	.5660	.5585	.5424	.5278	.5132	.4997	.4869	.6219
PLL OPT	184.36	249.25	292.09	323.03	337.31	346.23	363.97	377.67	388.29	396.55	402.97	409.93	150.93
PLL VAC	275.36	304.84	331.11	351.90	361.85	368.15	380.83	390.72	398.44	404.44	409.09	269.69	
SILCN	1.059	1.625	2.864	5.323	7.734	10.152	19.614	38.158	74.462	145.371	283.433	1.000	

	SHIFTING EXPANSION												
ESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	567.8
MP, DEG K	3663.6	3253.5	2674.2	2512.5	2167.7	1979.6	1851.4	1628.4	1518.6	1421.4	1348.2	1284.7	3407.1
ENTHALPY (-)	-7.35	32.73	67.73	98.17	124.43	137.92	146.84	165.92	183.00	198.57	212.86	226.10	17.91
X BAR	6.389	6.286	6.207	6.153	6.118	6.100	6.086	6.066	6.059	5.718	5.569	5.426	6.323
N	6.389	6.286	6.207	6.153	6.118	6.100	6.086	6.038	5.973	5.905	5.871	5.843	6.323
CP	1.2136	1.1727	1.0085	.8592	.7659	.7420	.7314	2.7605	3.0466	3.2895	6.4023	6.8456	1.2315
IMPLL OPT	186.72	255.57	302.98	338.59	355.49	366.25	388.25	406.94	423.25	437.69	450.65	448.22	
IMPLL VAC	281.41	315.91	347.09	372.45	384.86	392.85	410.03	425.64	439.85	452.52	464.03	273.88	
EPSILCN	1.075	1.721	3.159	6.092	9.030	12.020	24.720	53.894	118.903	266.809	604.322	1.000	

COMPOSITION SHIFTING (MOL/100 GM)												
132.60 E	.CC07	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
45.47 E*F	1.2988	1.2839	1.2670	1.2484	1.2261	1.2105	1.1988	1.1929	1.2140	1.2251	1.1039	.9686
-143.00 E*F*O	.6856	.7830	.8793	.9690	1.0372	1.0570	1.0586	.9664	.7712	.5732	.4832	.4111
-133.84 E*F2	.C232	.0171	.0128	.0096	.0068	.0051	.0039	.0021	.0017	.0012	.0008	.0005
-271.00 E*F3	.CC30	.0036	.0052	.0095	.0218	.0349	.0465	.0819	.1371	.1963	.2623	.3272
114.76 E*H	.CC01	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 E*H*O	.2929	.2578	.2148	.1671	.1255	.1109	.1058	.0858	.0496	.0290	.0178	.0111
-135.32 E*H*O2	.C363	.0340	.0290	.0219	.0148	.0118	.0101	.0058	.0023	.0008	.0004	.0002
61.00 E*H2	.CC18	.0007	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0010
-45.00 E*H2*O2	.CC00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 E*H3	.CC03	.0001	.0001	.0001	.0000	.0000	.0001	.0001	.0000	.0000	.0000	.0002
-238.60 E*H3*O3	.CC00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 E*O	.C635	.0474	.0217	.0073	.0017	.0006	.0003	.0001	.0000	.0000	.0000	.0002
-84.00 E*O2	.CC36	.0021	.0009	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0026
-111.60 E2*O2	.C116	.0112	.0103	.0089	.0082	.0090	.0108	.0128	.0061	.0030	.0015	.0008
-211.10 E2*O3	.CC15	.0019	.0022	.0024	.0028	.0035	.0045	.0057	.0023	.0009	.0005	.0018
-567.00 E3*F3*O3	.CC00	.0000	.0000	.0000	.0000	.0001	.0004	.0069	.0114	.0161	.0212	.0260
8.86 F	.CC11	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005
-64.50 F*H	.4035	.3322	.2570	.1794	.1022	.0618	.0366	.0144	.0102	.0066	.0051	.0040
-26.10 F*H*O	.CC00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F*O	.CC00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.CC F2	.CC00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F*	.4476	.2779	.1457	.0589	.0166	.0066	.0031	.0007	.0003	.0001	.0001	.0000
9.33 F*H	.CC38	.0012	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0019
.CC F2	3.0411	3.1988	3.3409	3.4608	3.5559	3.5867	3.6042	3.6303	3.6525	3.6722	3.6762	3.1394
-57.80 F2*O	.C486	.0328	.0193	.0093	.0033	.0016	.0009	.0002	.0001	.0000	.0000	.0000
59.56 E	.CC03	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
.CC O2	.CC00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-305.34 E2*O3/C	.CC00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0316	.1145	.2175	.2398
.CC E/C	.CC00	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0850	.1776

SYSTEM 0-12-H246										PC 1000 PSIA										PE C-1 PSIA									
COMPONENT										DENSITY										WT. O/D									
LEU K										GM/CC										(CAL/FORP.Wt.)									
OF2 128 OF2										1.31										+3.5									
P706 10C P706A										0.445										+2.50									
FROZEN EXPANSION																													
C STAR = 0.986-5 FT/SEC																													
ILFEN	PE/P	P PSIA	TEMP	ENTHALPY	CP CAL/G	1 OPT	DEL VAC	DEL VAC	1 SVA	1 T AT	1 T AT	1 VAC	CF SEAF	CF VAC															
				KCAL/100GM	CG DEG		/P	/P	1 LVL	10000	50000																		
	1.000	1000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00															
CCCC	1.018	550.0C2	3245.3	-16.14	0.422	150.9	118.8	-216	268.5	267.5	269.3	269.7	1.234	1.248															
CCCC	9.762	10.072	232.05E	-75.43	0.400	240.0	46.8	454	309.1	311.2	315.0	315.8	1.432	1.403															
CCCC	17.119	58.94	NA1 2031.8	-92.55	0.590	294.9	38.0	651	329.3	326.2	331.8	332.9	1.548	1.542															
CCCC	26.925	37.71	NA1 1849.8	-103.26	0.583	310.1	32.0	884	310.1	310.0	331.6	343.1	1.529	1.580															
CCCC	36.719	27.35	1727.4	-110.44	0.582	318.8	28.0	1194	319.1	338.9	346.6	350.1	1.547	1.694															
CCCC	47.474	21.604	1625.1	-116.28	0.572	327.9	27.4	1290	336.2	341.9	351.1	355.5	1.557	1.685															
CCCC	59.158	16.492	1547.1	-120.65	0.563	337.1	25.6	1515	337.1	343.8	356.8	359.3	1.561	1.686															
CCCC	71.448	14.100	1482.6	-124.34	0.565	336.5	24.2	1720	344.9	359.7	362.7	367.2	1.680																
CCCC	84.474	11.905	1467.7	-127.40	0.564	340.8	23.0	1951	345.5	359.1	365.5	369.1	1.693																
CCCC	97.421	10.211	1382.6	-130.07	0.560	345.8	22.1	2100	359.9	369.9	370.5	370.5	1.716																
CCCC	112.255	8.490	1339.1	-132.35	0.550	344.7	21.2	2381	365.8	369.9	371.1	371.1	1.713																
CCCC	127.274	7.657	1302.2	-134.44	0.554	341.2	20.5	2600	372.1	371.7	372.1	372.1	1.722																
CCCC	142.463	7.001	1269.1	-136.27	0.552	355.5	19.8	2831	368.5	373.1	372.9	372.9	1.729																
CCCC	158.155	6.495	1238.1	-137.93	0.554	355.9	19.0	3061	373.1	373.1	373.1	373.1	1.736																
CCCC	174.558	6.176	1211.8	-139.43	0.559	357.3	18.7	3276	370.5	370.1	371.1	371.1	1.742																
CCCC	191.370	5.925	1186.4	-140.80	0.567	359.0	18.3	3490	373.1	377.3	377.3	377.3	1.747																
CCCC	207.464	5.810	1163.7	-142.06	0.566	366.5	17.8	3705	372.0	378.4	378.4	378.4	1.752																
CCCC	224.475	5.455	1162.9	-143.24	0.569	361.9	17.4	3915	372.7	378.4	378.4	378.4	1.757																
CCCC	241.478	5.489	1122.5	-145.35	0.563	368.2	17.1	4134	373.1	380.3	380.3	380.3	1.761																
CCCC	258.455	5.465	1103.9	-146.51	0.567	464.4	16.7	4324	373.8	381.2	381.2	381.2	1.765																
CCCC	277.478	5.603	1083.5	-146.25	0.561	465.6	16.4	4550	374.2	382.0	382.0	382.0	1.769																
CCCC	297.048	5.168	1071.1	-147.18	0.560	366.6	16.1	4789	374.6	382.7	382.7	382.7	1.773																
CCCC	316.464	5.100	1054.7	-147.97	0.561	368.5	15.8	5002	375.1	383.1	383.1	383.1	1.777																
CCCC	337.119	5.268	1040.1	-146.76	0.538	365.5	15.6	5254	375.1	384.1	384.1	384.1	1.779																
CCCC	357.561	5.274	1026.3	-147.50	0.537	364.4	15.3	5496	375.4	384.7	384.7	384.7	1.782																
CCCC	378.187	5.044	1013.2	-147.20	0.536	376.2	15.1	5715	375.6	385.3	385.3	385.3	1.785																
CCCC	398.908	5.000	1000.7	-147.07	0.537	376.1	14.8	5910	375.6	385.9	385.9	385.9	1.788																
CCCC	419.646	5.192	986.9	-151.51	0.538	371.8	14.7	6167	375.6	386.0	386.0	386.0	1.790																
CCCC	440.820	5.228	977.5	-152.11	0.538	372.5	14.5	6380	375.1	387.0	387.0	387.0	1.792																
CCCC	461.829	5.105	966.7	-152.05	0.533	372.1	14.5	6506	376.2	387.4	387.4	387.4	1.795																
CCCC	482.825	5.071	956.3	-151.24	0.532	373.8	14.1	6721	376.3	387.4	387.4	387.4	1.797																
CCCC	504.003	5.085	946.3	-151.71	0.531	374.1	14.0	6928	376.3	387.4	387.4	387.4	1.799																
CCCC	524.656	4.908	936.8	-154.24	0.531	375.0	13.8	7128	376.4	388.8	388.8	388.8	1.801																
CCCC	545.570	4.833	927.6	-154.77	0.530	375.5	13.6	7341	376.5	389.2	389.2	389.2	1.803																
CCCC	566.248	4.766	918.7	-155.24	0.530	376.1	13.5	7545	376.5	389.6	389.6	389.6	1.804																
CCCC	586.966	4.704	910.2	-155.65	0.528	376.6	13.3	7743	376.5	390.0	390.0	390.0	1.805																
CCCC	607.568	4.646	902.0	-156.12	0.528	377.1	13.2	7923	376.5	390.4	390.4	390.4	1.806																
CCCC	627.744	4.593	894.0	-156.54	0.528	377.6	13.1	8104	376.5	390.7	390.7	390.7	1.809																
CCCC	651.242	4.536	886.3	-156.95	0.527	378.1	12.9	8303	376.5	391.0	391.0	391.0	1.811																
CCCC	675.556	4.480	878.9	-157.34	0.527	378.5	12.8	8484	376.5	391.3	391.3	391.3	1.813																
CCCC	699.105	4.424	871.7	-157.72	0.526	378.8	12.7	8658	376.5	391.6	391.6	391.6	1.815																
CCCC	725.107	4.375	864.7	-158.09	0.526	379.4	12.6	8826	376.5	391.9	391.9	391.9	1.817																
CCCC	750.233	4.333	858.0	-158.44	0.525	379.6	12.5	8981	376.5	392.1	392.1	392.1	1.818																
CCCC	775.566	4.284	851.0	-158.74	0.525	380.2	12.4	9133	376.5	392.4	392.4	392.4	1.819																
CCCC	801.105	4.245	844.1	-159.01	0.524	380.8	12.3	9281	376.5	392.6	392.6	392.6	1.820																
CCCC	826.955	4.205	837.4	-159.24	0.524	381.9	12.2	9425	376.5	392.8	392.8	392.8	1.821																
CCCC	852.841	4.173	832.9	-159.76	0.523	381.5	12.1	9564	376.5	392.9	392.9	392.9	1.822																
CCCC	878.934	4.138	827.0	-160.00	0.523	381.6	12.0	9699	376.5	393.0	393.0	393.0	1.823																
CCCC	905.115	4.105	821.4	-160.30	0.522	382.0	11.9	9829	376.5	393.1	393.1	393.1	1.824																
CCCC	931.584	4.071	816.1	-160.55	0.522	382.5	11.8	9955	376.5	393.2	393.2	393.2	1.825																
7.744	68.040	14.092	1498.7	-123.45	0.563	331.3	24.5	1.670	337.3	344.7	359.0	361.9	1.562	1.078															

PRESSURE PROFILE DATA
 SYSTEM C-F2-R2H6 PC 1000 PSIA PE 0.1 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. 0/0
 DEG K GM/CC (KCAL/FORM.WT.)
 OF2 126 0*F2 1.53 +3.5 70.0
 B2H6 180 B2H6 0.445 +2.50 30.0

BULK DENSITY = .884 GM/CC
 MIXTURE RATIO = 2.333 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 340.18 EU/100GMS

CHAMBER

THRUST

	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	554.3
PRESSURE, PSIA	398.5	3303.8	2727.2	2242.6	1835.7	1630.0	1494.7	1209.8	973.2	778.1	618.3	488.3	3536.6
TEMP, DEG K	-7.25	32.92	66.13	93.50	115.45	127.08	134.29	149.18	161.19	170.63	178.51	184.60	19.35
ENTHALPY (-)	.5915	.5810	.5706	.5581	.5449	.5364	.5301	.5146	.5005	.4871	.4741	.4621	.5848
CP	186.42	252.65	296.04	327.38	341.84	350.91	368.90	382.40	393.60	402.00	408.53	412.10	152.10
IMPLL OPT	279.13	308.96	335.56	356.63	366.72	373.13	386.00	396.06	403.91	410.02	414.77	273.40	
IMPLL VAC	1.058	1.624	2.862	5.322	7.735	10.155	19.638	38.240	74.690	145.974	284.932	1.000	
EPSILON													

	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	569.5
PRESSURE, PSIA	398.5	3575.3	3204.0	2859.9	2533.1	2353.5	2233.1	1979.0	1754.0	1537.5	1419.4	1346.4	3730.1
TEMP, DEG K	-7.25	34.05	70.37	102.33	130.37	145.03	154.86	176.25	194.99	211.33	225.70	238.91	18.63
ENTHALPY (-)	6.034	5.912	5.806	5.720	5.652	5.617	5.591	5.522	5.456	5.403	5.288	5.154	5.958
X BAR	6.034	5.912	5.806	5.720	5.652	5.617	5.591	5.522	5.456	5.403	5.288	5.154	5.958
N	1.4972	1.3864	1.2416	1.0741	.9422	.9259	.9459	.9976	.8925	.8877	4.7728	4.7811	1.4324
IMPLL OPT	189.55	259.85	308.75	346.01	363.98	375.54	399.54	419.45	436.07	450.17	462.76	150.04	
IMPLL VAC	285.95	321.74	354.55	381.78	395.38	404.28	423.18	439.17	452.54	464.59	475.72	278.09	
EPSILON	1.077	1.737	3.229	6.334	9.502	12.782	26.415	55.355	116.095	255.246	576.569	1.000	

	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
132.60 B	.0009	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005
-45.47 B*F	.9822	.9556	.9289	.9013	.8659	.8460	.8247	.7618	.6996	.6588	.6532	.6551	.9659
-143.00 B*F*0	.7898	.8947	.9962	1.0905	1.1703	1.2051	1.2235	1.2487	1.2567	1.2363	1.0795	.8861	.8542
-133.84 B*F2	.0299	.0225	.0174	.0141	.0120	.0110	.0102	.0072	.0040	.0017	.0010	.0007	.0251
-270.00 B*F3	.0040	.0045	.0058	.0093	.0200	.0350	.0521	.1107	.1732	.2162	.2598	.3207	.0042
114.76 B*H	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 B*H*0	.1933	.1676	.1367	.1024	.0683	.0519	.0428	.0297	.0252	.0269	.0215	.0141	.1782
-135.32 B*H*02	.0383	.0362	.0313	.0240	.0157	.0115	.0092	.0059	.0044	.0037	.0022	.0010	.0374
66.00 B*H2	.0008	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005
-45.00 B*H2*02	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 B*H3	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 B*H3*03	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 B*0	.1068	.0680	.0374	.0165	.0054	.0024	.0013	.0003	.0001	.0000	.0000	.0000	.0823
-84.00 B*02	.0076	.0050	.0028	.0012	.0004	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0060
-111.60 B2*02	.0056	.0049	.0040	.0028	.0017	.0012	.0010	.0007	.0009	.0019	.0019	.0011	.0052
-210.10 B2*03	.0011	.0012	.0012	.0011	.0008	.0007	.0006	.0005	.0008	.0021	.0020	.0010	.0011
-567.00 B3*F3*03	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	.0051	.0213	.0259	.0000
18.86 F	.0059	.0023	.0008	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0034
-64.50 F*H	.7429	.6814	.6145	.5446	.4683	.4142	.3677	.2354	.1082	.0301	.0146	.0103	.7062
-26.10 F*H*0	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F*0	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.7054	.5116	.3375	.1931	.0898	.0517	.0336	.0111	.0030	.0005	.0002	.0001	.5851
9.33 H*0	.0153	.0065	.0023	.0006	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0093
.00 H2	2.3197	2.4657	2.6453	2.7910	2.9151	2.9768	3.0175	3.1068	3.1792	3.2196	3.2312	3.2377	2.4215
-57.80 H2*0	.0822	.0628	.0439	.0272	.0143	.0091	.0064	.0026	.0009	.0002	.0001	.0000	.0704
59.56 0	.0026	.0008	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0013
.00 02	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-305.34 B2*03/0	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0390	.1037	.0000

SYSTEM 0-F2-B2H6
COMPONENT C6H K
OF2 120 04F2
B2H6 100 B2H6

PC ICCE PSIA
DENSITY
GM/CC 1.53
0.445
0.445

HEAT FORM
(KCAL/FORM.WT.)
+3.5
+2.50

PE 0.1 PSIA
WT. 0/B
7C.0
30.0

EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	C STAR = 701.0 / C PSUEC											
					CP CAL / I	OPT	DELTA V	CEL VAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC		
					DEG	DEG	DEG	DEG	LVL	LVL	50000	LVL	LVL	LVL	LVL	LVL
1.000	1.000	1000.000	3986.5	7.25	592	152.1	121.3	-216	270.2	271.2	273.0	273.4	1.235	1.249		
2.000	1.000	554.290	3986.5	-15.55	585	152.1	121.3	-216	270.2	271.2	273.0	273.4	1.235	1.249		
3.000	9.715	102.932	2521.7	-77.82	566	272.8	47.3	-660	313.5	315.4	319.3	320.1	1.432	1.463		
4.000	17.129	58.386	2207.8	-95.44	557	296.9	38.5	-666	327.7	330.6	336.3	337.4	1.498	1.542		
5.000	26.949	37.107	2010.4	-106.39	551	318.5	33.3	-666	334.6	338.0	346.7	347.8	1.529	1.589		
6.000	38.739	27.216	1812.3	-115.96	548	324.7	30.1	-666	338.0	343.5	352.9	354.9	1.547	1.627		
7.000	47.450	21.057	1706.9	-119.99	546	332.3	27.7	-1	337.347	346.5	357.8	360.1	1.557	1.664		
8.000	54.205	16.890	1622.4	-124.26	539	336.2	25.9	1	350.6	361.6	369.4	381.6	1.561	1.674		
9.000	59.423	14.003	1612.6	-128.01	536	340.0	24.5	1	352.9	369.6	376.6	390.6	1.600	1.680		
10.000	64.471	11.838	1553.3	-131.16	533	344.0	23.2	1	358.1	378.2	385.1	398.1	1.692	1.692		
10.000	67.900	10.215	1502.0	-133.43	530	350.4	22.4	2	189	369.1	376.1	391.1	1.727.8	1.703		
11.000	71.423	8.913	1453.1	-135.29	528	355.4	21.5	2	189	370.8	376.9	397.9	1.713	1.713		
12.000	72.138	7.862	1417.1	-138.35	526	356.0	20.8	2	189	372.2	378.7	401.1	1.721	1.721		
13.000	72.700	7.008	1381.3	-140.27	524	363.4	20.1	2	189	373.5	379.5	403.1	1.729	1.729		
14.000	75.057	6.305	1348.9	-141.97	522	368.2	19.5	2	189	374.5	379.8	408.1	1.736	1.736		
15.000	76.172	5.721	1316.4	-143.51	521	362.2	19.0	2	189	375.5	381.2	412.1	1.742	1.742		
16.000	76.159	5.251	1292.3	-144.91	519	363.8	18.5	2	189	376.3	382.4	417.1	1.747	1.747		
17.000	77.041	4.816	1267.4	-146.21	518	368.2	18.1	2	189	377.5	384.5	421.1	1.752	1.752		
18.000	77.413	4.401	1244.3	-147.40	517	370.0	17.7	2	189	377.7	385.5	426.1	1.757	1.757		
19.000	77.603	4.015	1222.8	-148.51	515	366.1	17.3	4	176	378.3	385.4	431.1	1.761	1.761		
20.000	77.978	3.676	1202.7	-149.55	514	369.3	17.0	4	183	378.6	386.1	436.1	1.765	1.765		
21.000	77.737	3.373	1184.8	-150.52	513	373.5	16.7	4	186	379.1	387.3	441.1	1.769	1.769		
22.000	77.644	3.103	1168.1	-151.42	512	377.5	16.4	4	186	379.4	387.3	446.1	1.773	1.773		
23.000	77.624	2.862	1152.4	-152.26	511	372.5	16.1	4	189	379.9	388.6	451.1	1.776	1.776		
24.000	77.656	2.647	1137.4	-153.05	510	373.5	15.8	5	325	380.2	389.3	456.1	1.779	1.779		
25.000	77.749	2.453	1123.6	-153.85	509	374.5	15.6	5	326	380.5	390.0	461.1	1.782	1.782		
26.000	77.730	2.285	1111.4	-154.57	508	378.6	15.4	5	326	380.7	390.7	466.1	1.785	1.785		
27.000	77.619	2.142	1099.9	-155.26	508	376.2	15.1	6	623	380.9	391.1	471.1	1.787	1.787		
28.000	77.405	2.016	1089.0	-155.91	507	377.5	14.9	6	625	381.0	391.7	476.1	1.790	1.790		
29.000	77.173	1.914	1078.7	-156.54	506	377.1	14.7	6	625	381.2	392.2	481.1	1.792	1.792		
30.000	76.925	1.831	1069.0	-157.12	505	377.0	14.5	6	625	381.3	392.7	486.1	1.794	1.794		
31.000	76.665	1.766	1060.7	-157.70	505	376.8	14.4	6	614	381.4	393.2	491.1	1.797	1.797		
32.000	76.395	1.690	1053.9	-158.24	504	376.4	14.2	7	112	381.5	393.6	496.1	1.799	1.799		
33.000	76.115	1.679	1048.5	-158.77	504	380.0	14.0	7	133	381.6	394.1	501.1	1.801	1.801		
34.000	75.825	1.653	1044.6	-159.27	503	381.6	13.9	7	133	381.6	394.5	506.1	1.803	1.803		
35.000	75.525	1.637	1042.0	-159.75	502	381.2	13.7	7	134	381.7	394.9	511.1	1.804	1.804		
36.000	75.215	1.630	1040.7	-160.21	502	381.7	13.6	7	134	381.7	395.3	516.1	1.806	1.806		
37.000	74.895	1.631	1040.8	-160.64	501	382.2	13.4	8	135	381.7	395.3	521.1	1.808	1.808		
38.000	74.565	1.637	1042.0	-161.04	501	382.7	13.3	8	135	381.7	395.3	526.1	1.809	1.809		
39.000	74.225	1.646	1044.6	-161.51	500	383.7	13.2	8	135	381.7	395.3	531.1	1.811	1.811		
40.000	73.875	1.656	1048.9	-161.91	500	383.6	13.0	8	131	381.7	396.7	536.1	1.813	1.813		
41.000	73.515	1.667	1054.0	-162.35	499	384.1	12.9	8	136	381.7	397.0	541.1	1.814	1.814		
42.000	73.145	1.679	1060.7	-162.80	499	384.6	12.8	8	136	381.7	397.0	546.1	1.815	1.815		
43.000	72.765	1.692	1068.9	-163.24	498	384.9	12.7	8	137	381.7	397.6	551.1	1.817	1.817		
44.000	72.375	1.706	1078.7	-163.64	498	385.3	12.6	8	132	381.7	398.2	556.1	1.818	1.818		
45.000	71.975	1.721	1089.0	-164.04	497	385.7	12.5	8	137	381.7	398.2	561.1	1.819	1.819		
46.000	71.565	1.737	1100.7	-164.44	497	386.1	12.4	8	137	381.7	398.2	566.1	1.821	1.821		
47.000	71.145	1.754	1113.4	-164.82	496	386.4	12.3	8	132	381.7	398.2	571.1	1.822	1.822		
48.000	70.715	1.772	1127.4	-165.20	496	386.8	12.2	8	132	381.7	398.2	576.1	1.823	1.823		
49.000	70.275	1.790	1142.4	-165.57	495	387.1	12.1	8	134	381.7	398.2	581.1	1.824	1.824		
50.000	69.825	1.808	1158.4	-165.94	495	387.5	12.0	8	134	381.7	398.2	586.1	1.825	1.825		
7.735	28.000	10.000	100.00	-172.00	536	180.1	25.0	1	393	361.8	364.3	365.8	1.562	1.070		

PRESSURE PROFILE DATA
 SYSTEM C-F2-B2+6 PC 1000 PSIA PE 0.1 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. C/O
 DEG K GM/CC (KCAL/FORM.WT.)
 CF2 128 0+F2 1.53 +3.5 74.0
 B2+6 180 B2+H6 0.445 +2.50 26.0

BULK DENSITY = .936 GM/CC
 MIXTURE RATIO = 2.846 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 327.11 EU/100GMS

CHAMBER

INLET

	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	.051
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	.051
TEMP, DEG K	4296.4	3550.8	2425.4	2401.7	1963.6	1742.5	1597.5	1292.2	1038.8	830.1	659.2	520.7	379.9
ENTHALPY (-)	-7.14	33.62	67.25	94.92	117.59	128.81	136.07	151.08	163.18	172.68	180.61	186.75	20.11
CF	.5510	.5421	.5332	.5230	.5113	.5037	.4984	.4841	.4709	.4582	.4460	.4345	.4244
IMPLL OPT	188.31	254.40	297.98	329.41	343.91	352.98	371.01	384.93	395.74	408.15	416.08	424.44	432.44
IMPLL VAC	281.09	310.98	337.64	358.74	368.84	375.25	388.15	398.21	406.06	412.17	416.12	419.36	422.50
EPSILON	1.058	1.620	2.853	5.259	7.699	10.107	15.537	36.026	74.236	145.010	282.931	1.00	

	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	.051
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	.051
TEMP, DEG K	4296.4	3873.4	3494.7	3159.6	2844.4	2668.1	2544.4	2268.4	2040.2	1855.3	1695.3	1545.8	1431.9
ENTHALPY (-)	-7.14	34.87	71.93	104.72	133.75	149.08	159.41	181.99	201.90	219.61	235.50	249.78	264.79
X BAR	5.692	5.559	5.439	5.332	5.242	5.197	5.167	5.097	5.018	4.934	4.852	4.781	4.719
N	5.692	5.559	5.439	5.332	5.242	5.197	5.167	5.097	5.018	4.934	4.852	4.781	4.719
CP	1.6549	1.5705	1.4518	1.3019	1.1280	1.0358	.9877	1.0073	1.1847	1.2995	1.2673	1.1054	1.6002
IMPLL OPT	191.18	262.28	311.95	350.11	368.65	380.65	405.63	426.44	444.15	459.45	472.77	481.15	488.15
IMPLL VAC	286.55	325.00	358.65	386.92	401.17	410.51	430.27	447.20	461.97	474.93	486.29	496.50	505.50
EPSILON	1.078	1.744	3.262	6.460	9.752	13.161	27.285	57.725	124.465	271.613	555.690	1.000	

	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
132.60 E	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.47 E+F	.6972	.6556	.6180	.5830	.5493	.5294	.5138	.4657	.3958	.3148	.2354	.1653	.0713
-143.00 E+F+O	.8380	.9448	1.0450	1.1368	1.2169	1.2564	1.2806	1.3216	1.3418	1.3514	1.3562	1.3562	.9038
-133.84 E+F2	.0323	.0237	.0177	.0137	.0111	.0102	.0096	.0084	.0064	.0042	.0023	.0011	.0267
-270.00 E+F3	.0044	.0045	.0049	.0063	.0059	.0147	.0207	.0530	.1164	.1956	.2748	.3451	.0044
114.76 E+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 E+H+O	.1221	.1073	.0900	.0707	.0508	.0397	.0325	.0191	.0117	.0079	.0057	.0044	.1133
-135.32 E+H+O2	.0375	.0375	.0346	.0291	.0216	.0170	.0139	.0080	.0051	.0037	.0030	.0027	.0378
66.00 E+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.00 E+H2+O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 E+H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 E+H3+O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 E+O	.1238	.0968	.0548	.0300	.0134	.0074	.0046	.0012	.0003	.0001	.0000	.0000	.1008
-64.00 E+O2	.0142	.0108	.0072	.0040	.0018	.0010	.0006	.0001	.0000	.0000	.0000	.0000	.0122
-111.60 E2+O2	.0028	.0024	.0020	.0014	.0009	.0007	.0005	.0002	.0001	.0001	.0001	.0001	.0026
-210.10 E2+O3	.0008	.0008	.0009	.0008	.0006	.0005	.0004	.0003	.0002	.0002	.0002	.0003	.0008
-567.00 E3+O3+O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.0228	.0108	.0046	.0017	.0005	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0147
-64.50 F+H	1.1049	1.0687	1.0228	.9729	.9219	.8903	.8647	.7778	.6412	.4795	.3200	.1792	1.0843
-26.10 F+H+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F+O	.9330	.7519	.5699	.3970	.2445	.1705	.1262	.0546	.0227	.0096	.0038	.0013	.8232
9.33 F+O	.0462	.0246	.0113	.0043	.0013	.0005	.0003	.0000	.0000	.0000	.0000	.0000	.0319
.00 F2	1.5517	1.7253	1.8756	2.0235	2.1598	2.2306	2.2770	2.3765	2.4712	2.5638	2.6492	2.7224	1.6680
-57.80 F2+O	.1132	.0967	.0771	.0566	.0373	.0275	.0213	.0108	.0056	.0030	.0017	.0008	.1036
59.56 O	.0148	.0059	.0020	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0087
.00 O2	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002

SYSTEM P-12-R246										PC 1000 PSIA		PC 0.1 PSIA	
COMPONENT										DENSITY	HEAT FORM	WT. 0/0	
										GM/CC	BTU/LB	BTU/LB	
										1.51	14.5	14.5	
										1.51	14.5	14.5	
										1.51	14.5	14.5	
										1.51	14.5	14.5	
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										1.51	14.5	14.5	

PRESSURE PROFILE DATA
 SYSTEM C-F2-B2H6 PC 1000 PSIA PE 0.1 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. G/O
 CEG K GM/CC (KCAL/FORM.WT.)
 OF2 128 O+O2 1.53 +3.5 78.0
 B2H6 180 B2+H6 0.445 +2.50 22.0

BULK DENSITY = .996 GM/CC
 MIXTURE RATIO = 3.545 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTRCPY 312.34 EU/100GMS

CHAMBER	FROZEN EXPANSION										THROAT		
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	549.7
TEMP, DEG K	4581.7	3773.6	3099.2	2536.9	2068.7	1833.2	1679.0	1355.2	1087.2	866.8	686.9	541.0	4040.2
ENTHALPY (-)	-7.04	33.75	67.29	94.81	117.29	128.39	135.58	150.38	162.50	171.83	179.41	185.40	20.35
CP	.5082	.5011	.4934	.4849	.4747	.4683	.4632	.4508	.4384	.4266	.4155	.4053	.5037
IMPLL OPT	188.38	254.30	297.67	328.87	343.25	352.24	370.07	383.87	394.47	402.74	409.16	415.38	154.38
IMPLL VAC	291.03	310.66	337.08	357.97	367.95	374.28	387.01	396.91	404.64	410.63	415.28	415.28	275.42
EPSILON	1.057	1.615	2.837	5.260	7.633	10.011	19.320	37.371	73.146	142.615	277.726	1.000	

	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	571.5
TEMP, DEG K	4581.7	4157.0	3780.2	3440.7	3130.2	2959.5	2840.3	2562.7	2294.0	2050.2	1841.7	1639.6	4317.3
ENTHALPY (-)	-7.04	35.15	72.52	105.72	135.27	150.96	161.60	165.02	205.76	224.05	240.23	254.52	19.21
X BAR	5.350	5.212	5.086	4.970	4.866	4.812	4.775	4.700	4.638	4.577	4.513	4.457	5.265
A	5.350	5.212	5.086	4.970	4.866	4.812	4.775	4.700	4.638	4.577	4.513	4.457	5.265
CP	1.6731	1.7884	1.6677	1.5241	1.3612	1.2565	1.1779	.9919	.8810	.7573	.6218	.4733	1.8271
IMPLL OPT	191.58	263.09	313.20	351.86	370.75	383.02	408.16	430.26	448.38	463.80	477.02	481.13	151.13
IMPLL VAC	289.36	326.26	360.40	399.78	403.95	417.64	434.23	451.64	466.47	479.29	490.26	490.26	281.16
EPSILON	1.079	1.752	3.288	6.346	9.930	13.455	28.123	59.280	126.036	271.054	582.045	1.000	

	COMPOSITION SHIFTING (MOL/100 GM)												
132.60 E	.0008	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005
-45.47 E+F	.4655	.4066	.3544	.3089	.2683	.2464	.2311	.1952	.1566	.1069	.0495	.0097	.4290
-143.00 E+H+E	.8363	.9425	1.0406	1.1293	1.2088	1.2506	1.2785	1.3373	1.3816	1.4062	1.4132	1.3981	.9018
-133.84 E+H	.0324	.0222	.0152	.0105	.0075	.0062	.0055	.0043	.0034	.0025	.0012	.0003	.0257
-270.00 E+H	.0048	.0042	.0039	.0039	.0044	.0051	.0059	.0101	.0237	.0598	.1149	.1672	.0044
114.76 E+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 E+H+E	.0672	.0596	.0515	.0429	.0338	.0284	.0246	.0161	.0092	.0048	.0024	.0010	.0626
-135.32 E+H+E2	.0318	.0348	.0362	.0353	.0319	.0288	.0262	.0190	.0123	.0082	.0075	.0122	.0338
66.00 E+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-45.00 E+H2+E2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 E+H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 E+H3+E3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 E+H	.1239	.0949	.0674	.0434	.0247	.0165	.0118	.0044	.0012	.0003	.0000	.0000	.1062
-84.00 E+H2	.0226	.0204	.0167	.0121	.0075	.0053	.0039	.0015	.0004	.0001	.0000	.0000	.0215
-111.60 E+H2	.0013	.0011	.0009	.0007	.0005	.0004	.0003	.0002	.0001	.0000	.0000	.0000	.0012
-210.10 E+H2+E3	.0005	.0006	.0007	.0007	.0006	.0006	.0005	.0004	.0003	.0002	.0002	.0003	.0006
-567.00 E+H3+E3+E3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.0715	.0403	.0208	.0097	.0040	.0023	.0014	.0004	.0001	.0000	.0000	.0000	.0510
-64.50 F+H	1.4363	1.4424	1.4311	1.4083	1.3796	1.3620	1.3492	1.3170	1.2727	1.1914	1.0790	.9788	1.4424
-26.10 F+H+E	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	1.0338	.9069	.7647	.6102	.4516	.3621	.3008	.1715	.0792	.0309	.0110	.0028	.9586
9.33 F+O	.1073	.0722	.0438	.0233	.0166	.0061	.0039	.0011	.0002	.0000	.0000	.0000	.0853
.00 H2	.9202	1.0040	1.1066	1.2235	1.3472	1.4188	1.4686	1.5786	1.6711	1.7501	1.8205	1.8662	.9687
-57.80 F+H2	.1252	.1217	.1134	.1002	.0827	.0713	.0628	.0428	.0259	.0160	.0133	.0201	.1236
59.56 C	.0648	.0357	.0169	.0067	.0021	.0009	.0005	.0001	.0000	.0000	.0000	.0000	.0458
.00 C2	.0034	.0017	.0007	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0023

PRESSURE PROFILE DATA
 SYSTEM C-F2-B2H6 PC 1000 PSIA PE 0.1 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORP.WT.)
 OF2 128 0*F2 1.53 +3.5 84.0
 B2H6 180 B2H6 0.445 +2.50 16.0

BULK DENSITY = 1.101 GM/CC
 MIXTURE RATIO = 5.250 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTRCPY 286.90 EU/100GMS

CHAMBER

THROAT

	1000	398.1	156.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	551.4
PRESSURE, PSIA	4876.7	3986.1	3249.4	2640.5	2137.7	1886.4	1722.5	1380.4	1099.4	870.2	684.8	535.8	4282.1
TEMP, DEG K	-6.89	32.25	64.20	90.21	111.30	121.67	128.35	142.04	152.99	161.68	168.54	173.92	19.30
ENTHALPY (-)	4421	4365	4305	4233	4152	4097	4053	3949	3841	3743	3654	3574	4386
CP	184.52	248.64	290.63	320.65	334.42	343.00	359.95	372.94	382.94	390.66	396.61	396.61	150.94
IMPLL OPT	274.93	303.36	328.66	348.55	358.03	364.01	375.99	385.27	392.45	397.99	402.26	402.26	269.66
IMPLL VAC	1.055	1.602	2.799	5.159	7.460	9.761	18.723	36.153	70.003	135.638	262.590	1.000	
EPSILON													

	1000	398.1	156.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	573.1
PRESSURE, PSIA	4876.7	4462.9	4099.0	3773.1	3477.5	3317.3	3206.8	2955.9	2717.2	2479.1	2224.5	1942.7	4619.8
TEMP, DEG K	-6.89	33.84	70.13	102.59	131.69	147.25	157.84	181.36	202.53	221.54	238.47	253.31	18.30
ENTHALPY (-)	4.841	4.700	4.569	4.446	4.331	4.267	4.223	4.123	4.034	3.959	3.904	3.874	4.755
X BAR	4.841	4.700	4.569	4.446	4.331	4.267	4.223	4.123	4.034	3.959	3.904	3.874	4.755
N	2.1796	2.1631	2.0836	1.9714	1.8363	1.7545	1.6876	1.6471	1.6279	.9465	.6695	.4945	2.1767
CP	188.24	258.84	308.61	347.21	366.18	378.56	404.68	426.83	445.78	462.01	475.77	488.03	
IMPLL OPT	284.56	321.40	355.61	384.72	399.60	409.49	430.72	449.03	464.81	478.26	489.45	496.32	
IMPLL VAC	1.081	1.763	3.328	6.670	10.160	13.817	29.217	62.579	134.770	289.048	610.984	1.000	
EPSILON													

COMPOSITION SHIFTING (MOL/100 GM)

132.60 B	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
-45.47 B=F	.2336	.1756	.1239	.0813	.0495	.0358	.0260	.0150	.0077	.0037	.0016	.0005	.1979
-143.00 B=F+C	.7438	.8312	.9056	.9644	1.0061	1.0231	1.0324	1.0471	1.0556	1.0625	1.0697	1.0740	.7980
-133.84 B=F2	.0336	.0209	.0121	.0064	.0032	.0021	.0015	.0007	.0003	.0001	.0001	.0000	.0254
-270.00 B=F3	.0077	.0060	.0044	.0031	.0021	.0017	.0014	.0010	.0008	.0008	.0011	.0026	.0067
114.76 B=F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 B=F+C	.0173	.0139	.0111	.0087	.0066	.0056	.0049	.0034	.0022	.0014	.0007	.0003	.0152
-135.32 B=F+O2	.0148	.0172	.0203	.0246	.0306	.0348	.0382	.0471	.0566	.0653	.0714	.0743	.0162
66.00 B=H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.00 B=H2+O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
16.00 B=H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 B=H3+O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 B=C	.0773	.0612	.0464	.0332	.0221	.0168	.0145	.0075	.0036	.0014	.0003	.0000	.0675
-64.00 B=C2	.0263	.0287	.0310	.0331	.0346	.0349	.0348	.0327	.0276	.0191	.0094	.0026	.0278
-111.60 B2=C2	.0003	.0002	.0001	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0002
-210.10 B2=C3	.0002	.0002	.0003	.0003	.0004	.0004	.0005	.0005	.0006	.0007	.0007	.0007	.0002
-567.00 B3=F3+O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.2763	.1958	.1313	.0823	.0481	.0339	.0259	.0127	.0054	.0018	.0004	.0000	.2258
-64.50 F+H	1.7669	1.8487	1.9129	1.9608	1.9947	2.0090	2.0173	2.0317	2.0393	2.0404	2.0361	2.0286	1.8185
-26.10 F+H+C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F=C	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.7715	.7058	.6364	.5604	.4763	.4244	.3863	.2945	.2057	.1241	.0563	.0153	.7320
9.33 F=O	.1926	.1688	.1475	.1280	.1090	.0976	.0890	.0674	.0446	.0233	.0078	.0013	.1779
.00 F2	.2709	.2687	.2715	.2782	.2926	.2962	.2962	.3037	.3104	.3203	.3358	.3497	.2691
-57.80 F2+O	.0811	.0676	.0480	.1142	.1378	.1553	.1696	.2079	.2490	.2861	.3116	.3240	.0847
59.56 C	.2521	.2392	.1897	.1440	.1031	.0818	.0678	.0392	.0183	.0058	.0009	.0000	.2598
.00 C2	.0339	.0303	.0267	.0233	.0196	.0173	.0155	.0109	.0060	.0021	.0003	.0000	.0317

SYSTEM G-F2-P2M6										PC 1000 PSIA										PE C.I. PSIA									
COMPONENT										DENSITY										WT. O/D									
REF. FORMULA										CP/CL										HEAT FORM.									
CEG K										+3.5										+3.5									
OF2										0.445										0.445									
P2M6										0.445										0.445									
FROZEN EXPANSION										C STAR = 0.0216 FT/SEC										C STAR = 0.0216 FT/SEC									
EPSILON										I SEA										I SEA									
PC/P										I AT										I AT									
P PSIA										I VAC										I VAC									
TEMP										CF SEA										CF SEA									
ENTHALPY										CF VAC										CF VAC									
CP CAL/ I OPT										DEL VAC										DEL VAC									
CEG K										DEL VAC										DEL VAC									
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SYSTEM O-F2-B2H6
 COMPONENT TREF FORMULA PC 300 PSIA PE 0.1 PSIA
 DEG K DENSITY GM/CC HEAT FORM (KCAL/FORM.WT.) WT. O/O
 OF2 120 OF2 1.53 +3.5 74.0
 B2H6 180 B2H6 0.445 +2.30 26.0

BULK DENSITY = .936 GM/CC
 MIXTURE RATIO = 2.846 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 340.88 EU/100GMS

CHAMBER	FROZEN EXPANSION												THROAT
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	165.2
TEMP, DEG K	4061.8	3377.0	2799.5	2313.2	2113.3	1906.1	1560.4	1272.1	1031.4	831.8	667.1	532.1	3579.6
ENTHALPY (-)	-7.14	30.19	61.19	86.86	97.26	108.02	125.41	139.62	151.18	160.53	168.04	174.06	19.21
CP	.5492	.5407	.5324	.5226	.5178	.5117	.4997	.4862	.4740	.4622	.4507	.4401	.5435
IMPUL OPT	180.23	243.82	285.97	301.37	316.53	339.58	357.32	371.12	381.92	390.39	397.03	397.03	151.40
IMPUL VAC	274.54	301.62	326.68	336.67	346.81	362.71	375.24	385.11	392.88	398.99	403.78	403.78	270.41
EPSILON	1.042	1.523	2.562	3.334	4.547	8.289	15.329	28.563	53.422	100.050	187.291	1.000	
SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	171.5
TEMP, DEG K	4061.8	3709.4	3394.2	3107.8	2981.5	2841.5	2586.0	2334.6	2098.4	1905.2	1749.6	1614.5	3830.6
ENTHALPY (-)	-7.14	31.46	65.91	96.77	110.06	124.43	149.23	171.36	191.02	208.51	224.25	238.50	18.16
X BAR	5.822	5.681	5.551	5.434	5.384	5.330	5.242	5.169	5.102	5.026	4.944	4.866	5.730
N	5.822	5.681	5.551	5.434	5.384	5.330	5.242	5.169	5.102	5.026	4.944	4.866	5.730
CP	1.9735	1.8871	1.7665	1.6061	1.5170	1.4042	1.1797	1.0018	1.0329	1.2544	1.3971	1.3771	1.9224
IMPUL OPT	183.26	252.11	300.66	319.32	338.33	368.83	394.07	415.20	433.14	448.66	462.27	468.36	
IMPUL VAC	282.67	316.72	349.22	362.78	377.03	400.60	420.54	437.50	452.26	465.33	476.97	476.97	276.27
EPSILON	1.060	1.645	2.951	3.965	5.613	10.999	21.875	43.964	89.963	187.278	393.982	1.000	
COMPOSITION SHIFTING (MOL/100 GM)													
132.60 B	.0008	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004
-45.47 B+F	.6874	.6477	.6136	.5839	.5711	.5573	.5327	.5066	.4658	.4003	.3231	.2468	.6611
-143.00 B+F+O	.8760	.9737	1.0637	1.1448	1.1792	1.2155	1.2739	1.3172	1.3429	1.3545	1.3598	1.3626	.9397
-133.84 B+F2	.0205	.0151	.0114	.0088	.0079	.0071	.0061	.0056	.0052	.0041	.0028	.0016	.0168
-270.00 B+F3	.0024	.0024	.0025	.0029	.0033	.0040	.0069	.0163	.0471	.1090	.1854	.2618	.0024
114.76 B+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 B+H+O	.1000	.0893	.0767	.0625	.0556	.0476	.0329	.0201	.0114	.0069	.0047	.0034	.0933
-135.32 B+H+O2	.0317	.0317	.0296	.0255	.0231	.0200	.0137	.0081	.0044	.0027	.0019	.0014	.0320
66.00 B+H2	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-45.00 B+H2+O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 B+H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 B+H3+O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 B+O	.1375	.1001	.0671	.0405	.0305	.0212	.0089	.0028	.0007	.0002	.0001	.0000	.1131
-84.00 B+O2	.0159	.0124	.0087	.0053	.0040	.0027	.0011	.0003	.0001	.0000	.0000	.0000	.0137
-111.60 B2+O2	.0022	.0019	.0016	.0012	.0010	.0008	.0005	.0002	.0001	.0001	.0000	.0000	.0020
-210.10 B2+O3	.0007	.0007	.0007	.0007	.0006	.0006	.0004	.0002	.0001	.0001	.0001	.0001	.0007
567.00 B3+F3+O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.0239	.0121	.0057	.0024	.0016	.0009	.0003	.0001	.0000	.0000	.0000	.0000	.0156
-64.50 F+H	1.1052	1.0699	1.0275	.9833	.9631	.9409	.9010	.8567	.7802	.6506	.4959	.3426	1.0836
-26.10 F+H+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	1.1562	.9624	.7658	.5738	.4880	.3949	.2389	.1194	.0498	.0208	.0091	.0039	1.0326
9.33 H+O	.0443	.0250	.0126	.0055	.0036	.0020	.0006	.0001	.0000	.0000	.0000	.0000	.0311
.00 H2	1.5069	1.6484	1.7959	1.9419	2.0076	2.0793	2.2014	2.3028	2.3884	2.4736	2.5594	2.6405	1.5967
-57.80 H2+O	.0914	.0795	.0651	.0499	.0429	.0351	.0221	.0120	.0058	.0030	.0016	.0009	.0840
59.56 O	.0187	.0082	.0031	.0010	.0005	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0112
.00 O2	.0004	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002

SYSTEM 8-72-B2M4 PC 800 PSIA
COMPONENT TRF FORMULA DENSITY HEAT FORM PE 0.1 PSIA
DEG K : GM/CC (KCAL/FORM.WT.)
B2M4 120 B0P2 1.53 23.5 74.0
B2M4 180 B2M4 0.449 22.50 26.0

EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	C STAR = 4953.4 FT/SEC		I SEA	I AT	I AT	I VAC	CF SEA	CF VAC
					CP CAL/ I OPT	DELVAC DELVAC						
			DEG K	KCAL/100GM	GM DEG	/P	LVL	10000	50000		LVL	
1.000	1.000	300.000	5001.8	7.14	549	151.4	119.0	229.8	263.0	269.2	270.4	1.231
2.000	0.753	30.761	2517.0	-76.17	527	269.8	44.2	1.501	293.9	300.6	313.4	1.360
3.000	17.433	17.209	2190.4	-93.26	520	295.6	37.3	2.167	301.0	310.6	329.2	1.393
4.000	26.908	11.149	1987.4	-103.75	514	310.6	32.2	2.888	313.2	317.9	342.8	1.586
5.000	37.478	8.005	1854.7	-111.06	510	320.7	28.9	3.618		343.5	349.6	1.618
6.000	49.248	6.092	1736.3	-116.37	506	326.1	26.4	4.370		347.2	354.7	1.641
7.000	61.528	4.876	1644.9	-120.92	503	333.0	24.9	5.100		350.0	358.7	1.660
8.000	73.898	4.060	1578.8	-124.49	500	338.4	23.5	5.784		352.0	361.9	1.674
9.000	87.617	3.424	1518.4	-127.50	498	342.3	22.3	6.420		353.5	364.6	1.687
10.000	102.471	2.928	1466.2	-130.09	496	346.3	21.3	7.022		354.4	366.9	1.698
11.000	117.778	2.547	1420.5	-132.35	493	348.6	20.5	7.604		355.1	368.9	1.707
12.000	133.326	2.250	1380.1	-134.36	492	350.9	19.8	8.165		355.6	370.4	1.715
13.000	148.936	2.014	1343.8	-136.12	490	353.0	19.2	8.708		356.0	372.2	1.722
14.000	164.473	1.824	1311.1	-137.72	488	355.0	18.6	9.230		356.2	373.6	1.729
15.000	179.858	1.668	1281.3	-139.17	487	356.6	18.1	9.737			374.3	1.734
16.000	196.889	1.524	1254.0	-140.50	485	358.4	17.6	11.558			376.0	1.740
17.000	215.200	1.394	1228.8	-141.72	484	359.9	17.2	12.327			377.1	1.745
18.000	235.939	1.282	1205.4	-142.85	483	361.2	16.8	13.095			378.0	1.749
19.000	255.031	1.186	1183.7	-143.90	482	362.5	16.4	13.866			378.9	1.753
20.000	272.402	1.101	1163.5	-144.88	481	363.7	16.1	14.640			379.8	1.757
21.000	291.980	1.027	1144.5	-145.79	480	364.8	15.8	15.368			380.5	1.761
22.000	311.700	.962	1126.7	-146.64	479	365.8	15.5	16.105			381.3	1.764
23.000	331.503	.905	1109.9	-147.46	478	366.7	15.2	16.830			382.0	1.767
24.000	351.336	.851	1094.1	-148.25	477	367.4	15.0	17.548			382.4	1.770
25.000	371.135	.800	1079.1	-148.91	477	368.5	14.7	18.234			383.2	1.773
26.000	390.935	.767	1064.9	-149.59	476	369.3	14.5	18.912			383.8	1.776
27.000	410.643	.731	1051.3	-150.23	475	370.0	14.3	19.574			384.3	1.778
28.000	430.269	.697	1038.4	-150.85	474	370.7	14.1	20.230			384.8	1.781
29.000	451.129	.665	1026.1	-151.43	474	371.6	13.9	20.911			385.3	1.783
30.000	473.916	.633	1014.3	-151.99	473	372.1	13.7	21.676			385.8	1.785
31.000	497.037	.604	1003.1	-152.52	472	372.7	13.5	22.443			386.2	1.787
32.000	520.465	.576	992.3	-153.03	472	373.3	13.4	23.210			386.7	1.789
33.000	544.170	.551	981.9	-153.52	471	373.9	13.2	23.976			387.1	1.791
34.000	568.141	.528	971.9	-153.99	471	374.4	13.1	24.741			387.5	1.793
35.000	592.336	.506	962.3	-154.46	470	374.9	12.9	25.504			387.8	1.795
36.000	616.735	.486	953.1	-154.88	470	375.4	12.8	26.264			388.2	1.796
37.000	641.313	.468	944.2	-155.29	469	375.9	12.6	27.021			388.6	1.798
38.000	666.064	.450	935.4	-155.70	468	376.4	12.5	27.772			388.9	1.799
39.000	690.907	.434	927.2	-156.09	468	376.8	12.4	28.519			389.2	1.801
40.000	715.877	.419	919.2	-156.46	468	377.3	12.3	29.260			389.5	1.802
41.000	740.935	.405	911.4	-156.82	467	377.7	12.1	29.995			389.8	1.804
42.000	766.059	.392	903.9	-157.18	467	378.1	12.0	30.723			390.1	1.805
43.000	791.232	.379	896.6	-157.52	466	378.5	11.9	31.444			390.4	1.806
44.000	816.436	.367	889.5	-157.85	466	378.9	11.8	32.158			390.7	1.808
45.000	841.656	.356	882.7	-158.17	465	379.2	11.7	32.864			390.9	1.809
46.000	866.879	.346	876.0	-158.48	465	379.6	11.6	33.562			391.2	1.810
47.000	892.093	.336	869.5	-158.78	465	379.9	11.5	34.254			391.4	1.811
48.000	917.283	.327	863.2	-159.07	464	380.3	11.4	34.933			391.7	1.812
49.000	942.446	.318	857.1	-159.36	464	380.6	11.3	35.606			391.9	1.813
50.000	967.573	.310	851.1	-159.63	463	380.9	11.2	36.271			392.2	1.814
53.334	20.414	14.696	2113.3	-97.26	518	301.4	35.3	2.402	301.4	312.0	332.6	1.394

SHIFTING EXPANSION C STAR = 7196.8 FT/SEC													
EPSILON	PC/P	P PSIA	TEMP DEG K	ENTHALPY KCAL/100GM	CP CAL GM DEG	I OPT	DELVAC DELVAC	I SEA LVL	I AT 10000	I AT 50000	I VAC	CF SEA LVL	CF VAC
1.000	1.000	300.000	5001.8	7.14	1.973	148.4	127.9	265.3	268.6	275.0	276.3	1.235	1.186
2.000	1.174	17.151	2517.0	-76.17	1.922	148.4	44.2	1.501	293.9	300.6	313.4	1.360	1.404
3.000	13.923	21.547	2190.4	-93.26	1.901	301.0	44.2	2.239	317.1	327.0	346.2	1.417	1.564
4.000	20.662	14.919	1977.8	-107.45	1.914	319.8	43.3	2.984	332.5	336.1	363.2	1.623	1.623
5.000	27.518	10.764	1887.2	-119.79	1.942	332.3	40.2	3.737	344.1	346.1	372.5	1.665	1.665
6.000	35.312	8.351	1787.9	-126.79	1.932	341.7	37.9	4.486		371.9	379.6	1.696	1.696
7.000	43.704	6.896	1755.8	-132.97	1.929	349.5	36.1	5.245		376.3	385.3	1.722	1.722
8.000	52.142	5.736	1705.0	-137.94	1.284	355.3	34.7	6.039		379.7	390.0	1.743	1.743
9.000	60.657	4.946	1660.7	-142.20	1.265	360.5	33.6	6.791		382.5	394.1	1.761	1.761
10.000	69.123	4.302	1620.9	-145.93	1.210	365.7	32.6	7.514		384.7	397.5	1.777	1.777
11.000	77.467	3.673	1586.0	-149.23		368.8	31.8	8.204		386.6	400.6	1.790	1.790
12.000	87.034	3.447	1559.3	-152.20		372.3	31.0	8.998		388.0	403.3	1.803	1.803
13.000	96.625	3.096	1523.7	-154.89		375.3	30.3	9.793		389.1	405.8	1.814	1.814
14.000	106.772	2.810	1489.3	-157.34		378.3	29.7	10.584		390.0	408.0	1.824	1.824
15.000	116.816	2.516	1456.9	-159.58		381.2	29.1	11.369		390.7	410.1	1.833	1.833
16.000	126.694	2.304	1424.7	-161.64		383.2	28.7	12.139		391.2	411.9	1.841	1.841
17.000	136.966	2.190	1392.5	-163.59		385.4	28.2	12.896		391.7	413.7	1.849	1.849
18.000	146.998	2.041	1360.4	-165.39		387.4	27.8	13.635		392.0	415.3	1.856	1.856
19.000	156.922	1.912	1328.1	-167.07		389.2	27.4	14.359		392.3	416.8	1.863	1.863
20.000	166.757	1.799	1296.5	-168.64		391.1	27.1	15.054		392.5	418.1	1.869	1.869
21.000	176.477	1.700	1264.9	-170.13		392.7	26.7	15.735			419.5	1.875	1.875
22.000	186.275	1.611	1233.2	-171.53		394.3	26.4	16.413			420.7	1.880	1.880
23.000	196.126	1.535	1202.2	-172.86		395.8	26.1	17.082			421.9	1.885	1.885
24.000	206.015	1.462	1171.5	-174.13		397.1	25.9	17.744			423.0	1.890	1.890
25.000	220.279	1.362	1140.7	-175.33		398.4	25.6	18.395			424.0	1.895	1.895
26.000	231.491	1.294	1110.3	-176.48		399.7	25.3	19.037			425.0	1.900	1.900
27.000	243.354	1.232	1080.1	-177.58		400.9	25.1	20.366			426.0	1.904	1.904
28.000	255.332	1.175	1050.2	-178.62		402.0	24.9	21.090			426.9	1.908	1.908
29.000	267.411	1.122	1020.3	-179.63		403.1	24.6	21.796			427.7	1.912	1.912
30.000	278.626	1.070	990.7	-180.59		404.1	24.4	22.715			428.6	1.915	1.915
31.000	290.063	1.032	962.5	-181.52		405.1	24.2	23.488			429.4	1.919	1.919
32.000	302.508	.992	934.7	-182.41		406.1	24.1	24.255			430.1	1.922	1.922
33.000	315.047	.951	907.1	-183.27		407.0	23.9	24.999			430.9	1.926	1.926
34.000	326.619	.907	880.4	-184.09		407.9	23.7	25.767			431.6	1.929	1.929
35.000	337.962	.868	853.7	-184.89		408.7	23.5	26.511			432.3	1.932	1.932
36.000	349.717	.830	828.4	-185.67		409.6	23.4	27.247			432.9	1.935	1.935
37.000	361.421	.795	803.4	-186.41		410.4	23.2	27.964			433.6	1.938	1.938
38.000	373.083	.763	778.4	-187.14		411.3	23.1	28.693			434.2	1.941	1.941
39.000	384.681	.730	753.4	-187.84		411.9	22.9	29.402			434.8	1.943	1.943
40.000	396.216	.707	728.2	-188.52		412.6	22.8	30.102			435.4	1.946	1.946
41.000	407.684	.686	703.2	-189.17		413.3	22.7	30.793			435.9	1.949	1.949
42.000	419.094	.667	678.7	-189.81		413.9	22.5	31.481			436.5	1.951	1.951
43.000	430.416	.647	654.3	-190.44		414.6	22.4	32.144			437.0	1.953	1.953
44.000	441.738	.629	629.8	-191.04		415.2	22.3	32.818			437.5	1.955	1.955
45.000	453.030	.609	605.4	-191.63		415.8	22.2	33.484			438.0	1.958	1.958
46.000	464.302	.590	581.0	-192.20		416.4	22.1	34.149			438.5	1.960	1.960
47.000	475.546	.569	556.9	-192.76		417.0	21.9	34.814			439.0	1.962	1.962
48.000	486.758	.547	532.2	-193.30		417.6	21.8	35.499			439.4	1.964	1.964
49.000	507.432	.521	508.6	-193.83		418.1	21.7	36.782			439.9	1.966	1.966
50.000	520.763	.500	484.3	-194.35		418.7	21.6	37.577			440.3	1.968	1.968

PRESSURE PROFILE DATA
 SYSTEM 0-F2-B2H6 PC 300 PSIA PE 0.1 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. 0/0
 DEG K GM/CC (KCAL/FORM.WT.)
 OF2 128 0*F2 1.53 +3.5 78.0
 B2H6 180 B2*H6 0.445 +2.50 22.0

BULK DENSITY = .996 GM/CC
 MIXTURE RATIO = 3.545 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 325.30 EU/100GMS

	CHAMBER										THROAT														
	FROZEN										EXPANSION														
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	164.0												
TEMP, DEG K	4309.7	3569.6	2949.0	2428.8	2215.8	1993.3	1828.9	1324.5	1071.2	861.5	689.2	548.4	3782.6												
ENTHALPY (-)	-7.04	30.22	61.04	86.47	96.75	107.38	124.50	138.46	149.79	158.92	166.25	172.10	19.55												
CP	.5070	.5000	.4928	.4846	.4802	.4751	.4642	.4526	.4412	.4303	.4198	.4103	.5022												
IMPUL OPT	180.05	243.36	285.22	300.49	315.50	338.28	355.78	369.37	379.97	388.27	394.77	394.77	152.09												
IMPUL VAC	274.07	300.83	325.61	335.46	345.46	361.12	373.44	383.12	390.73	396.69	401.35	270.04													
EPSILON	1.040	1.518	2.546	3.310	4.508	8.201	15.133	28.136	52.506	98.116	183.253	1.000													

	SHIFTING EXPANSION																							
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	171.8											
TEMP, DEG K	4309.7	3569.6	3639.5	3351.9	3226.0	3088.1	2842.6	2609.3	2380.6	2151.3	1936.6	1755.0	4078.8											
ENTHALPY (-)	-7.04	31.62	66.24	97.35	110.79	125.35	150.58	173.35	193.82	212.15	228.46	243.00	18.19											
X BAR	5.486	5.343	5.211	5.089	5.035	4.977	4.875	4.785	4.710	4.649	4.592	4.531	5.394											
N	5.486	5.343	5.211	5.089	5.035	4.977	4.875	4.785	4.710	4.649	4.592	4.531	5.394											
CP	2.2242	2.1333	2.0089	1.8653	1.7905	1.7002	1.5080	1.2885	1.0591	.8960	.9340	.9736	2.1688											
IMPUL OPT	183.40	252.50	301.35	320.17	339.37	370.31	396.14	418.01	436.67	452.63	466.39	468.15												
IMPUL VAC	283.05	317.44	350.29	364.03	378.52	402.66	423.39	441.20	456.47	469.62	481.13	276.53												
EPSILON	1.061	1.650	2.968	3.994	5.667	11.177	22.470	45.642	93.020	190.462	394.428	1.000												

	COMPOSITION SHIFTING (MOL/100 GM)															
132.60 B	.0007	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	
-45.47 B*F	.4561	.3972	.3464	.3033	.2855	.2667	.2348	.2062	.1796	.1516	.1112	.0572	.4176			
-143.00 B*F*O3	.8695	.9689	1.0596	1.1410	1.1758	1.2128	1.2753	1.3286	1.3722	1.4044	1.4221	1.4276	.9341			
-133.84 B*F2	.0208	.0143	.0098	.0068	.0058	.0049	.0036	.0028	.0023	.0020	.0016	.0009	.0163			
-270.00 B*F3	.0027	.0024	.0021	.0020	.0020	.0021	.0024	.0034	.0062	.0157	.0461	.0977	.0025			
114.76 B*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000			
-47.13 B*H*O3	.0529	.0476	.0420	.0360	.0330	.0295	.0229	.0165	.0107	.0061	.0031	.0016	.0495			
-135.32 B*H*O2	.0258	.0285	.0300	.0299	.0292	.0278	.0240	.0187	.0130	.0078	.0047	.0039	.0276			
66.00 B*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000			
-45.00 B*H2*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000			
18.00 B*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000			
-238.60 B*H3*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000			
5.74 B*O	.1334	.1047	.0774	.0532	.0433	.0333	.0186	.0088	.0033	.0009	.0002	.0000	.1150			
-84.00 B*O2	.0244	.0225	.0191	.0147	.0125	.0101	.0060	.0030	.0011	.0003	.0001	.0000	.0234			
-111.60 B2*O2	.0010	.0009	.0007	.0006	.0005	.0004	.0003	.0002	.0001	.0000	.0000	.0000	.0009			
-210.10 B2*O3	.0004	.0005	.0006	.0006	.0006	.0006	.0005	.0004	.0003	.0002	.0001	.0001	.0005			
-567.00 B3*F3*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000			
18.86 F	.0750	.0441	.0242	.0123	.0088	.0058	.0025	.0009	.0003	.0001	.0000	.0000	.0538			
-64.50 F*H	1.4386	1.4430	1.4328	1.4127	1.4013	1.3877	1.3619	1.3375	1.3137	1.2817	1.2143	1.1092	1.4433			
-26.10 F*H*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000			
32.40 F*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000			
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000			
52.10 H	1.2517	1.1209	.9745	.8141	.7358	.6453	.4771	.3193	.1839	.0849	.0326	.0119	1.1699			
9.33 H*O	.1001	.0705	.0456	.0266	.0198	.0137	.0081	.0022	.0006	.0001	.0000	.0000	.0807			
.00 H2	.8513	.9316	1.0289	1.1400	1.1952	1.2593	1.3795	1.4936	1.5944	1.6772	1.7471	1.8133	.9006			
-57.80 H2*O3	.0978	.0968	.0924	.0841	.0790	.0724	.0582	.0430	.0284	.0163	.0092	.0071	.0975			
59.56 O	.0799	.0468	.0243	.0109	.0071	.0042	.0013	.0003	.0000	.0000	.0000	.0000	.0575			
.00 O2	.0036	.0019	.0009	.0003	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0024			

SYSTEM 00-02-0246				THERM FORMULA				PC 300 PSIA				DENSITY				HEAT FORM				PE 0.1 PSIA			
COMPONENT				DEG K				128 00F2				1.53				+3.5				78.0			
00F2				120 00F2				160 00F2				0.445				+2.50				22.0			
0246				160 0246				160 0246				0.445				+2.50				22.0			
FREEZE EXPANSION																							
C STAR 4 4039.0 FT/SEC																							
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/G	I OPT	DELVAC	DELVAC	I SEAL	I AT	CP SEAT	CP SEAT	CP SEAT	CP SEAT	CP SEAT	CP SEAT	CP SEAT	CP SEAT	CP SEAT				
		P PSIA	TEMP	ENTHALPY	CP CAL/G	I OPT	DELVAC	DELVAC	I SEAL	I AT	CP SEAT	CP SEAT	CP SEAT	CP SEAT	CP SEAT	CP SEAT	CP SEAT	CP SEAT	CP SEAT				
1.000	1.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000				
1.000	1.829	184.047	378.24	17.04	.302	152.1	117.9	.719	259.5	266.7	268.8	270.0	1.203	1.251	1.299	1.347	1.395	1.443	1.491				
2.000	8.938	300.93	2641.5	-76.14	.400	249.6	45.7	1.490	293.3	292.9	312.7	315.3	1.203	1.251	1.299	1.347	1.395	1.443	1.491				
3.000	17.617	11.029	2292.4	-93.06	.482	295.1	34.8	2.002	300.2	309.7	328.9	331.9	1.392	1.439	1.486	1.533	1.580	1.627	1.674				
4.000	27.231	17.071	2076.1	-105.43	.477	310.0	31.8	2.882															
5.000	37.987	2.787	1924.4	-110.46	.465	327.3	28.5	3.985															
6.000	49.952	6.006	1809.4	-116.07	.470	327.3	26.2	4.363															
7.000	62.416	4.806	1717.9	-120.36	.467	332.9	24.5	5.088															
8.000	76.954	4.002	1642.5	-123.87	.465	337.5	23.1	5.766															
9.000	90.479	3.346	1573.8	-126.83	.463	341.3	21.9	6.398															
10.000	104.215	2.769	1507.3	-129.38	.460	345.0	20.7	6.787															
11.000	119.797	2.504	1475.3	-131.59	.459	347.3	20.1	8.041															
12.000	135.465	2.212	1432.6	-133.55	.457	349.7	19.4	8.777															
13.000	151.546	1.981	1394.4	-135.29	.456	351.9	18.8	8.888															
14.000	167.214	1.794	1360.4	-136.84	.454	354.0	18.2	10.187															
15.000	182.819	1.641	1328.5	-138.28	.453	355.6	17.7	10.790															
16.000	200.761	1.495	1299.7	-139.59	.452	357.2	17.3	11.544															
17.000	219.421	1.367	1273.1	-140.78	.450	358.6	16.8	12.112															
18.000	238.570	1.257	1248.5	-141.89	.449	360.0	16.4	12.679															
19.000	258.070	1.162	1225.7	-142.91	.448	361.2	16.1	13.641															
20.000	277.841	1.080	1204.4	-143.87	.447	362.3	15.8	14.595															
21.000	297.812	1.007	1184.8	-144.76	.447	363.4	15.5	15.340															
22.000	317.914	.944	1165.7	-145.59	.446	364.4	15.2	16.033															
23.000	338.087	.888	1148.1	-146.38	.445	365.3	14.9	16.689															
24.000	358.279	.837	1131.4	-147.12	.444	366.2	14.6	17.494															
25.000	378.490	.793	1115.7	-147.82	.443	367.0	14.4	18.181															
26.000	398.586	.753	1101.7	-148.48	.443	367.8	14.2	18.852															
27.000	418.649	.715	1088.6	-149.11	.442	368.5	14.0	19.511															
28.000	438.566	.684	1077.9	-149.71	.441	369.3	13.8	20.164															
29.000	461.178	.651	1060.0	-150.28	.441	369.9	13.6	20.889															
30.000	484.553	.619	1047.6	-150.82	.440	370.6	13.4	21.633															
31.000	508.265	.590	1039.8	-151.34	.439	371.2	13.2	22.419															
32.000	532.287	.561	1028.5	-151.86	.439	371.8	13.1	23.248															
33.000	556.591	.539	1013.6	-152.32	.438	372.3	12.9	23.949															
34.000	581.149	.516	1003.1	-152.78	.438	372.9	12.8	24.711															
35.000	605.933	.495	993.0	-153.22	.437	373.4	12.6	25.471															
36.000	630.918	.475	983.3	-153.64	.437	374.0	12.5	26.228															
37.000	656.076	.457	974.0	-154.05	.436	374.6	12.3	26.980															
38.000	681.382	.440	965.0	-154.44	.436	374.8	12.2	27.727															
39.000	706.812	.424	956.3	-154.82	.435	375.3	12.1	28.469															
40.000	732.347	.410	947.7	-155.19	.435	375.7	12.0	29.209															
41.000	757.972	.397	939.2	-155.57	.435	376.1	11.9	29.944															
42.000	783.621	.383	931.8	-155.88	.434	376.5	11.7	30.656															
43.000	809.330	.371	924.2	-156.22	.434	376.9	11.6	31.370															
44.000	835.082	.359	916.8	-156.54	.433	377.2	11.5	32.076															
45.000	860.918	.347	909.5	-156.85	.433	377.6	11.4	32.784															
46.000	886.538	.336	902.6	-157.15	.433	377.9	11.3	33.445															
47.000	912.254	.324	895.8	-157.44	.432	378.3	11.2	34.147															
48.000	937.947	.312	889.2	-157.73	.432	378.6	11.1	34.860															
49.000	963.665	.301	882.8	-158.01	.431	378.9	11.0	35.585															
50.000	989.273	.290	876.5	-158.28	.431	379.2	10.9	36.312															
3.310	20.414	16.964	2215.8	-96.73	.402	300.5	20.5	2.380	300.5	311.0	331.4	335.5	1.393	1.559	1.725	1.891	2.057	2.223	2.389				

PRESSURE PROFILE DATA
 SYSTEM O-F2-B2H6 PC 900 PSIA PE 0.1 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/G
 DEG K GM/CC (KCAL/FORM.WT.)
 OF2 128 O=F2 1.53 +3.5 84.0
 B2H6 180 B2=H6 0.445 +2.50 16.0

BULK DENSITY = 1.101 GM/CC
 MIXTURE RATIO = 5.250 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 298.64 EU/100GMS

CHAMBER	FROZEN EXPANSION										THROAT		
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	163.3
TEMP, DEG K	4568.9	3756.7	3081.1	2519.5	2291.0	2053.1	1665.8	1344.9	1079.9	862.4	685.1	541.6	3985.8
ENTHALPY (-)	-6.89	28.73	57.98	81.94	91.57	101.50	117.40	130.28	140.65	148.95	155.57	160.81	18.72
CP	.4410	.4359	.4298	.4232	.4194	.4149	.4059	.3962	.3863	.3772	.3689	.3615	.4373
IMPUL OPT	176.03	237.55	277.99	292.67	307.07	328.83	345.44	358.26	368.20	375.94	381.96	381.96	149.27
IMPUL VAC	267.61	293.21	316.88	326.26	335.76	350.57	362.15	371.19	378.25	383.76	388.04	388.04	263.86
EPSILON	1.039	1.507	2.513	3.258	4.424	8.001	14.677	27.121	50.298	93.414	173.463	1.000	

CHAMBER	SHIFTING EXPANSION										THROAT		
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	172.2
TEMP, DEG K	4568.9	4225.3	3918.4	3640.2	3518.4	3385.4	3151.0	2934.7	2732.9	2540.1	2347.6	2141.6	4345.1
ENTHALPY (-)	-6.89	30.29	63.76	94.00	107.12	121.37	146.21	168.76	189.28	207.96	224.92	240.26	17.24
X BAR	4.964	4.823	4.692	4.569	4.514	4.452	4.342	4.238	4.142	4.054	3.978	3.919	4.873
N	4.964	4.823	4.692	4.569	4.514	4.452	4.342	4.238	4.142	4.054	3.978	3.919	4.873
CP	2.5622	2.5226	2.4292	2.3045	2.2436	2.1766	2.0489	1.9031	1.7101	1.4432	1.1148	.7855	2.5451
IMPUL OPT	179.83	247.91	296.25	314.93	334.03	364.94	390.90	413.10	432.33	449.07	463.68	444.89	
IMPUL VAC	277.81	312.02	344.78	358.52	373.04	397.35	418.41	436.79	452.92	467.05	479.33	271.24	
EPSILON	1.062	1.659	2.998	4.043	5.752	11.406	23.104	47.486	98.534	205.358	426.602	1.000	

COMPOSITION SHIFTING (MOL/100 GM)													
132.60 B	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
-45.47 B=F	.2376	.1798	.1286	.0861	.0696	.0537	.0314	.0175	.0094	.0050	.0025	.0012	.2002
-143.00 B=F=O	.7593	.8406	.9104	.9662	.9871	1.0067	1.0326	1.0468	1.0538	1.0580	1.0626	1.0691	.8123
-133.84 B=F2	.0227	.0143	.0084	.0046	.0034	.0024	.0011	.0005	.0002	.0001	.0001	.0000	.0170
-270.00 B=F3	.0047	.0036	.0027	.0019	.0016	.0013	.0008	.0006	.0004	.0003	.0003	.0004	.0040
114.76 B=H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 B=H=O	.0130	.0106	.0086	.0069	.0062	.0055	.0042	.0031	.0022	.0015	.0010	.0006	.0114
-135.32 B=H=O2	.0109	.0126	.0149	.0182	.0202	.0228	.0291	.0367	.0455	.0547	.0632	.0698	.0119
66.00 B=H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.00 B=H2=O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 B=H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 B=H3=O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 B=O	.0807	.0649	.0504	.0373	.0319	.0262	.0172	.0105	.0059	.0030	.0013	.0004	.0705
-84.00 B=O2	.0261	.0286	.0312	.0339	.0352	.0365	.0385	.0390	.0372	.0321	.0235	.0130	.0277
-111.60 B2=O2	.0002	.0001	.0001	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0002
-210.10 B2=O3	.0001	.0002	.0002	.0002	.0002	.0003	.0003	.0004	.0005	.0006	.0006	.0007	.0001
-567.00 B3=F3=O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.2931	.2128	.1471	.0961	.0772	.0591	.0342	.0186	.0094	.0043	.0016	.0004	.2403
-64.50 F=H	1.7618	1.8384	1.9002	1.9479	1.9658	1.9831	2.0081	2.0254	2.0367	2.0427	2.0434	2.0393	1.8124
-26.10 F=H=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.9159	.8482	.7775	.7003	.6614	.6149	.5220	.4252	.3292	.2374	.1522	.0778	.8730
9.33 H=O	.1668	.1492	.1339	.1203	.1143	.1074	.0939	.0787	.0612	.0424	.0240	.0095	.1553
.00 H2	.2416	.2412	.2451	.2533	.2582	.2644	.2765	.2873	.2959	.3035	.3138	.3295	.2408
-57.80 H2=O	.0579	.0629	.0709	.0835	.0914	.1023	.1285	.1617	.2003	.2408	.2780	.3056	.0608
59.56 O	.3400	.2861	.2351	.1875	.1605	.1436	.1041	.0699	.0420	.0210	.0076	.0015	.3053
.00 O2	.0316	.0291	.0267	.0244	.0233	.0221	.0194	.0159	.0116	.0069	.0028	.0006	.0300

SYSTEM 0-F2-02M6										PC 300 PSIA		HEAT FORM		PE 0.1 PSIA	
COMPONENT										DENSITY		[KCAL/FORM.WT.]		WT. G/G	
REF FORMULA										G/CC		1.53		84.0	
0-F2										0.445		+2.50		16.0	
02M6										0.445		+2.50		16.0	
PROZEN EXPANSION										C STAR		771.7 FT/SEC			
										I SEAT		I AT		I AT	
										LVL		10000		50000	
										I VAC		CF SEA		CF VAC	
										LVL		LVL		LVL	
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DELVAC	DELVAC	I SEAT	I AT	I AT	I VAC	CF SEA	CF VAC	
			DEG K	KCAL/100GM	GM DEG		/P	/P	LVL	10000	50000		LVL		
1.000	1.000	300.000	4568.9	6.89	.441	.437	149.3	114.6	.702	253.6	256.7	262.7	263.9	1.205	1.254
1.000	1.837	153.358	3985.8	-12.72	.437	.426	268.7	13.8	1.465	284.0	282.5	305.0	307.5	1.390	1.441
3.000	18.020	16.448	2540.4	-68.45	.421	.288.3	35.1	2.110	292.4	301.8	319.8	323.4	1.369	1.537	
4.000	27.960	10.730	2128.1	-98.38	.416	.102.6	30.2	2.812		303.9	328.0	332.8	1.581		
5.000	39.158	7.661	1965.8	-103.11	.413	.312.2	27.0	3.526			333.2	339.2	1.611		
6.000	51.584	5.810	1843.1	-110.17	.410	.519.1	24.8	4.259			336.6	343.9	1.634		
7.000	64.492	4.652	1745.8	-116.15	.408	.724.5	23.1	4.961			339.1	347.4	1.651		
8.000	77.445	3.874	1665.9	-117.40	.406	.928.8	21.7	5.613			341.0	350.6	1.666		
9.000	92.587	3.240	1598.2	-120.14	.404	.132.4	20.6	6.305			342.2	353.1	1.678		
10.000	108.420	2.767	1538.9	-122.49	.402	.335.5	19.7	7.115			343.1	355.2	1.688		
11.000	124.681	2.400	1489.0	-124.54	.401	.538.1	18.9	7.850			343.6	357.0	1.696		
12.000	141.134	2.126	1444.1	-126.34	.399	.740.5	18.2	8.559			344.0	358.6	1.704		
13.000	157.990	1.904	1403.8	-127.94	.398	.942.5	17.4	9.237			344.3	360.1	1.711		
14.000	173.924	1.725	1367.6	-129.38	.397	.144.3	17.0	9.881			344.5	361.4	1.717		
15.000	190.971	1.571	1334.4	-130.69	.396	.346.0	16.4	10.558			344.5	362.5	1.722		
16.000	210.214	1.427	1304.3	-131.89	.395	.547.9	16.1	11.267			344.5	363.6	1.727		
17.000	229.977	1.304	1276.5	-132.98	.394	.748.8	15.7	12.036			344.5	364.5	1.732		
18.000	250.172	1.199	1250.7	-133.99	.393	.950.1	15.3	12.782			344.5	365.4	1.736		
19.000	270.708	1.108	1226.8	-134.93	.392	.151.3	15.0	13.522			344.5	366.2	1.740		
20.000	291.500	1.029	1204.4	-135.80	.391	.352.3	14.7	14.252			344.5	367.0	1.744		
21.000	312.440	.960	1183.7	-136.62	.390	.553.3	14.4	14.971			344.5	367.7	1.747		
22.000	333.543	.899	1164.2	-137.38	.390	.754.3	14.1	15.675			344.5	368.4	1.750		
23.000	354.600	.848	1145.8	-138.10	.389	.955.2	13.8	16.364			344.5	369.0	1.753		
24.000	375.711	.798	1128.4	-138.77	.388	.156.0	13.6	17.037			344.5	369.5	1.756		
25.000	396.836	.756	1112.0	-139.41	.388	.356.8	13.4	17.693			344.5	370.1	1.758		
26.000	417.831	.718	1096.4	-140.01	.387	.557.5	13.2	18.331			344.5	370.6	1.761		
27.000	438.741	.684	1081.7	-140.58	.386	.758.2	13.0	18.953			344.5	371.1	1.763		
28.000	462.494	.652	1067.5	-141.12	.386	.958.8	12.8	19.568			344.5	371.6	1.766		
29.000	487.029	.616	1054.1	-141.64	.385	.159.5	12.6	20.169			344.5	372.1	1.768		
30.000	511.940	.584	1041.2	-142.14	.385	.360.1	12.4	21.776			344.5	372.5	1.770		
31.000	537.195	.558	1029.0	-142.61	.384	.560.6	12.2	21.923			344.5	372.9	1.772		
32.000	562.763	.533	1017.2	-143.06	.384	.761.2	12.1	22.609			344.5	373.3	1.773		
33.000	588.411	.510	1005.9	-143.50	.383	.961.7	11.9	23.283			344.5	373.6	1.775		
34.000	614.708	.488	995.0	-143.91	.383	.162.2	11.8	24.154			344.5	374.0	1.777		
35.000	641.024	.468	984.6	-144.31	.382	.362.7	11.6	24.890			344.5	374.3	1.779		
36.000	667.527	.449	974.6	-144.69	.382	.563.1	11.5	25.623			344.5	374.7	1.780		
37.000	694.188	.432	964.9	-145.06	.382	.763.6	11.4	26.349			344.5	375.0	1.782		
38.000	720.983	.414	955.6	-145.42	.381	.964.0	11.3	27.070			344.5	375.3	1.783		
39.000	747.882	.401	946.6	-145.76	.381	.164.4	11.1	27.784			344.5	375.6	1.784		
40.000	774.863	.387	937.9	-146.09	.380	.364.8	11.0	28.491			344.5	375.8	1.786		
41.000	801.901	.374	929.4	-146.41	.380	.565.2	10.9	29.190			344.5	376.1	1.787		
42.000	828.977	.362	921.3	-146.72	.380	.765.6	10.8	29.882			344.5	376.4	1.788		
43.000	856.073	.350	913.4	-147.02	.379	.965.9	10.7	30.565			344.5	376.6	1.789		
44.000	883.172	.340	905.8	-147.31	.379	.166.3	10.6	31.239			344.5	376.9	1.791		
45.000	910.261	.330	898.3	-147.59	.379	.366.6	10.5	31.905			344.5	377.1	1.792		
46.000	937.327	.320	891.1	-147.87	.378	.566.9	10.4	32.562			344.5	377.3	1.793		
47.000	964.362	.311	884.1	-148.13	.378	.767.2	10.3	33.210			344.5	377.5	1.794		
48.000	991.359	.303	877.3	-148.39	.378	.967.5	10.2	33.850			344.5	377.8	1.795		
49.000	1018.314	.295	870.7	-148.64	.378	.167.8	10.2	34.481			344.5	378.0	1.796		
50.000	1045.224	.287	864.3	-148.88	.377	.368.1	10.1	35.104			344.5	378.2	1.797		
52.58	20.414	14.496	2291.0	-91.37	.419	.292.7	33.6	2.286	292.7	302.8	322.4	326.3	1.391	1.550	

SHIFTING EXPANSION															
C STAR = 7001.7 FT/SEC															
EPSILON	PC/P	P PSIA	TEMP DEG K	ENTHALPY KCAL/100GM	CP CAL/ GM DEG	I OPT	DELVAC DELVAC /P	I SEAT LVL	I AT 10000	I AT 50000	I VAC	CF SEA	CF VAC	CP SEA	CF VAC
1.000	1.000	300.000	4568.9	6.89	2.542	.437	149.3	126.3	.734	240.5	243.7	270.0	271.2	1.212	1.183
2.000	7.976	17.615	3819.7	-74.51	2.390	.266.7	54.9	1.513	301.3	308.0	321.0	323.6	1.369	1.470	
3.000	13.610	22.043	3439.9	-94.03	2.304	.296.3	48.5	2.201	312.5	322.2	341.1	344.0	1.420	1.567	
4.000	20.132	14.902	3522.6	-106.67	2.246	314.3	43.7	2.934	314.9	327.9	353.1	358.1	1.431	1.627	
5.000	27.104	11.068	3437.0	-115.65	2.203	326.8	40.7	3.677		329.7	361.2	367.5	1.670		
6.000	36.334	8.718	3370.1	-123.00	2.168	336.2	38.5	4.409			361.2	374.7	1.702		
7.000	42.138	7.119	3315.2	-126.85	2.140	343.7	36.8	5.175			371.7	380.5	1.729		
8.000	50.175	5.979	3268.9	-133.76	2.115	349.8	35.5	5.939			375.2	385.3	1.751		
9.000	58.287	5.147	3228.9	-137.99	2.094	355.0	34.4	6.686			378.0	389.5	1.769		
10.000	66.348	4.522	3193.9	-141.49	2.074	359.5	33.5	7.407			380.4	393.8	1.786		
11.000	74.283	4.039	3162.8	-144.97	2.056	363.5	32.7	8.097			382.4	398.2	1.800		
12.000	82.798	3.623	3134.7	-147.92	2.039	367.0	32.0	8.833			383.9	399.0	1.813		
13.000	91.938	3.263	3109.2	-150.60	2.024	370.2	31.4	9.617			385.1	401.5	1.824		
14.000	101.222	2.914	3084.9	-153.04	2.009	373.6	30.8	10.399			386.1	403.5	1.835		
15.000	110.594	2.713	3064.4	-155.29	1.996	376.2	30.3	11.178			386.9	406.0	1.844		
16.000	120.002	2.500	3044.5	-157.37	1.982	378.0	29.9	11.947			387.5	407.9	1.851		
17.000	129.461	2.318	3026.0	-159.38	1.970	380.2	29.5	12.703			388.0	409.7	1.863		
18.000	139.000	2.152	3008.9	-161.25	1.957	382.3	29.1	13.446			388.4	411.2	1.870		
19.000	148.026	2.027	2993.5	-162.98	1.947	384.2	28.7	14.169			388.7	412.6	1.876		
20.000	157.197	1.908	2977.1	-164.57	1.935	386.0	28.4	14.876			389.0	414.4	1.883		
21.000	166.249	1.805	2962.7	-165.87	1.925	387.7	28.1	15.564			389.2	415.8	1.889		
22.000	175.174	1.713	2949.0	-167.28	1.914	389.3	27.8	16.233			389.4	417.1	1.895		
23.000	184.000	1.632	2936.1	-168.82	1.904	390.8	27.5	16.892			389.6	418.3	1.900		
24.000	194.081	1.548	2923.6	-169.90	1.894	392.2	27.3	17.640			389.8	419.5	1.906		
25.000	204.455	1.467	2911.8	-171.12	1.885	393.5	27.0	18.427			389.9	420.7	1.911		
26.000	214.923	1.396	2900.5	-172.28	1.875	394.8	26.8	19.207			390.1	421.6	1.916		
27.000	225.475	1.331	2889.5	-173.40	1.866	396.0	26.6	19.977			390.2	422.5	1.920		
28.000	236.087	1.271	2879.3	-174.46	1.857	397.2	26.4	20.766			390.3	423.4	1.924		
29.000	246.754	1.216	2869.3	-175.48	1.848	398.3	26.2	21.544			390.4	424.3	1.929		
30.000	257.480	1.165	2859.7	-176.47	1.840	399.4	26.0	22.318			390.5	425.5	1.933		
31.000	268.194	1.119	2850.4	-177.41	1.831	400.4	25.8	23.088			390.6	426.3	1.937		
32.000	279.000	1.076	2841.2	-178.32	1.823	401.3	25.7	23.849			390.7	427.1	1.940		
33.000	289.964	1.036	2832.9	-179.20	1.815	402.4	25.5	24.617			390.8	427.9	1.944		
34.000	301.000	.999	2824.5	-180.05	1.807	403.3	25.3	25.373			390.9	428.6	1.947		
35.000	311.148	.966	2816.5	-180.87	1.799	404.2	25.2	26.123			391.0	429.3	1.951		
36.000	321.373	.932	2808.9	-181.66	1.791	405.0	25.0	26.868			391.1	430.0	1.954		
37.000	332.544	.902	2801.1	-182.43	1.784	405.8	24.9	27.602			391.2	430.7	1.957		
38.000	343.176	.874	2793.7	-183.17	1.776	406.6	24.8	28.330			391.4	431.4	1.960		
39.000	353.763	.848	2786.5	-183.90	1.769	407.2	24.6	29.051			391.5	432.0	1.963		
40.000	364.299	.823	2779.4	-184.60	1.761	407.8	24.5	29.766			391.6	432.7	1.966		
41.000	374.788	.798	2772.4	-185.28	1.754	408.3	24.4	30.475			391.7	433.4	1.969		
42.000	385.202	.779	2766.2	-185.94	1.747	409.3	24.3	31.164			391.8	434.1	1.971		
43.000	395.564	.758	2759.8	-186.59	1.740	410.3	24.2	31.853			391.9	434.9	1.974		
44.000	405.863	.739	2753.5	-187.21	1.733	410.9	24.0	32.532			392.0	435.6	1.976		
45.000	416.099	.717	2747.1	-187.81	1.727	411.6	23.9	33.206			392.1	436.3	1.979		
46.000	426.271	.704	2741.3	-188.38	1.720	412.0	23.8	33.875			392.2	437.0	1.981		
47.000	436.285	.687	2735.4	-188.90	1.713	412.8	23.7	34.524			392.3	437.8	1.983		
48.000	446.280	.671	2730.0	-189.37	1.707	413.4	23.6	35.238			392.4	438.5	1.986		
49.000	456.273	.654	2724.4	-189.12	1.700	414.1	23.5	35.913			392.5	439.3	1.988		
50.000	466.240	.637	2718.9	-189.77	1.693	414.7	23.4	36.589			392.6	440.0	1.990		
50.003	70.416	14.996	3518.4	-107.12	2.244	314.9	34.9	11.906	314.9	328.1	353.5	358.5	1.431	1.421	

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OF₂ - B₅H₉ SYSTEM

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 100C PSIA
 COMPOSITION REF FORMULA DENSITY HEAT FURN WT. C/O
 DEG K GP/CC (KCAL/FORM.WT.)
 12H O*F2 1.53 +3.5 66.
 29H B5*H7 0.620 +7.74 54.

BULK DENSITY = 1.021 GM/CC
 MIXTURE RATIO = 1.941 LH OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA													
CHAMBER ENTROPY 509.95 EU/100GMS													
CHAMBER							THROAT						
FROZEN EXPANSION													
PRESSURE, PSIA	1000	398.1	151.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	555.1
TEMP, DEG K	3944.5	3273.1	2708.0	2233.1	1934.5	1632.8	1500.3	1220.6	987.4	794.1	634.4	503.3	3502.3
ENTHALPY (-)	-8.44	26.73	55.87	79.95	99.77	109.62	116.02	129.27	140.02	148.70	155.66	161.19	14.78
CP	.5277	.5196	.5116	.5019	.4917	.4850	.4801	.4673	.4549	.4420	.4286	.4156	.5226
IMPUL OPT	174.93	236.54	277.31	306.42	320.48	327.06	346.13	359.39	369.74	377.84	384.16	384.16	142.15
IMPL VAC	261.30	289.48	314.48	334.42	344.00	350.10	362.41	372.07	379.66	385.59	390.20	392.58	255.88
EPSILON	1.059	1.027	1.004	0.985	0.963	0.941	0.922	0.906	0.891	0.876	0.861	0.846	1.000
SHIFTING EXPANSION													
PRESSURE, PSIA	1000	398.1	151.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	568.9
TEMP, DEG K	3944.5	3527.8	3153.4	2804.5	2465.6	2269.2	2125.9	1806.6	1614.2	1501.5	1414.5	1343.3	5683.3
ENTHALPY (-)	-8.44	27.66	59.35	87.17	111.49	124.13	132.54	150.48	165.81	179.67	192.33	204.00	14.23
X BAR	5.339	5.233	5.142	5.070	5.021	5.003	4.995	4.982	4.974	4.968	4.963	4.959	5.273
N	5.339	5.233	5.142	5.070	5.021	5.003	4.995	4.982	4.974	4.968	4.963	4.959	5.273
CP	1.2649	1.1763	1.0480	.8880	.7248	.6453	.6011	.5529	1.9661	2.3315	4.0620	5.4724	1.2158
IMPUL OPT	177.23	242.85	288.41	323.02	339.61	350.22	371.84	389.36	404.54	417.93	429.91	440.44	
IMPL VAC	267.26	300.57	331.03	356.15	368.51	376.47	392.76	406.97	419.97	431.65	442.25	454.99	
EPSILON	1.076	1.733	3.214	6.276	9.358	12.490	25.015	52.879	116.354	259.908	587.271	1.000	
COMPOSITION SHIFTING (MOL/100 GM)													
132.60 H	.0026	.0009	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0014
-45.47 F*F	1.5151	1.5115	1.5063	1.5002	1.4940	1.4882	1.4825	1.4765	1.4703	1.4643	1.4581	1.4518	
-143.00 F*F*O	.6067	.6195	.7487	.8124	.8675	.8935	.9081	.9232	.9371	.9500	.9633	.9761	
-133.64 F*F*2	.0011	.0144	.0097	.0065	.0047	.0032	.0026	.0015	.0011	.0008	.0006	.0004	
-270.00 F*F*3	.0014	.0013	.0013	.0014	.0018	.0024	.0032	.0038	.0045	.0054	.0064	.0075	
114.76 F*F	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-47.13 F*F*O	.3017	.2905	.2740	.2518	.2237	.2050	.1910	.1775	.1637	.1554	.1515	.1493	
-135.32 F*F*O2	.0296	.0299	.0287	.0259	.0215	.0183	.0158	.0101	.0048	.0018	.0009	.0004	
66.00 F*F*2	.0024	.0011	.0004	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-45.00 F*F*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
18.00 F*F*3	.0002	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-238.60 F*F*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
5.74 F*F	.1655	.1144	.0705	.0365	.0143	.0068	.0036	.0005	.0001	.0000	.0000	.0000	
-84.00 F*F*2	.0058	.0040	.0024	.0012	.0004	.0002	.0001	.0000	.0000	.0000	.0000	.0000	
199.30 F*F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-111.60 F*F*O2	.0177	.0194	.0213	.0235	.0264	.0289	.0314	.0341	.0369	.0395	.0423	.0455	
-210.10 F*F*O3	.0017	.0023	.0030	.0040	.0054	.0067	.0079	.0126	.0094	.0055	.0016	.0008	
-567.00 F*F*O3*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-541.69 F*F*O3*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
18.86 F	.0021	.0007	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-64.50 F*F	.2743	.2200	.1660	.1148	.0692	.0469	.0335	.0120	.0063	.0031	.0014	.0007	
-26.10 F*F*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
32.40 F*F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
.00 F*F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
52.10 F	.5424	.3826	.2434	.1319	.0550	.0276	.0152	.0025	.0007	.0003	.0002	.0001	
9.33 F*F	.0055	.0021	.0007	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
.00 F*F	1.8119	1.9361	2.0506	2.1511	2.2333	2.2708	2.2928	2.3306	2.3641	2.3906	2.4102	2.4102	
-57.80 F*F*O	.0305	.0220	.0145	.0083	.0039	.0022	.0013	.0003	.0001	.0000	.0000	.0000	
59.56 O	.0009	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
.00 O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
34.10 O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-305.34 B2*O3/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0529	.1279	.1618	.1862	
.00 F/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.1373	

SYSTEM LIQUID HYDROPELLANT										PC 1000, PSIA		DENSITY		HEAT FORM.		HT. D/D	
COMPONENT										REF. FORMULA		LVL		LVL		LVL	
LEG. K										LEG. K		LVL		LVL		LVL	
126.0852										1.553		5.53		5.53		5.53	
200.0540										0.020		0.020		0.020		0.020	
FROZEN EXPANSION										C STAN = 0.0020 FT/SEC		I SEA		I AT		I VAC	
Epsilon										PC/P		P PSIA		TEMP		ENTHALPY	
1.000										1.000		1.000		1.000		1.000	
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1.000										1.000		1.000		1.000		1.000	
1.000										1.000		1.000		1.000		1.000	
1.000										1.000		1.000		1.000		1.000	
1.000										1.000		1.000		1.000		1.000	
1.000										1.000		1.000		1.000		1.000	
1.000										1.000		1.000		1.000		1.000	
1.000										1.000		1.000					

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 LEG K
 12H O*F2 1.53 +3.5 72.
 298 B3*F9 0.620 +7.14 24.
 BULK DENSITY = 1.084 GM/CC
 MIXTURE RATIO = 2.571 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 298.60 EU/100GMS

CHAMBER	THROAT									
	FROZEN EXPANSION									
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631
TEMP, DEG K	4462.1	3689.4	3042.9	2502.4	2051.4	1824.1	1675.0	1361.5	1100.7	884.9
ENTHALPY (-)	-7.10	29.19	59.98	85.35	106.18	116.51	123.22	137.10	148.36	157.44
X BAR	.4855	.4795	.4726	.4657	.4573	.4477	.4372	.4261	.4149	.4032
CP	180.11	243.36	285.12	315.30	329.25	337.99	355.41	366.93	379.49	387.74
IMPLL OPT	268.88	297.54	323.16	343.49	351.76	359.47	372.01	381.86	389.59	395.64
IMPLL VAC	1.058	1.622	2.860	5.326	7.752	10.191	19.787	38.711	76.002	149.363
EPSILON										
	SHIFTING EXPANSION									
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631
TEMP, DEG K	4462.1	4023.4	3635.6	3295.7	2983.1	2810.3	2688.8	2404.7	2142.6	1923.8
ENTHALPY (-)	-7.10	30.32	64.21	94.21	120.84	134.94	144.48	165.40	183.82	200.07
X BAR	5.012	4.893	4.782	4.682	4.594	4.549	4.520	4.460	4.404	4.342
A	5.012	4.893	4.782	4.682	4.594	4.549	4.520	4.460	4.404	4.342
CP	1.4945	1.4410	1.3691	1.2638	1.1221	1.0266	.9579	.8313	.6831	.5192
IMPLL OPT	182.82	250.80	298.34	334.91	352.75	364.33	388.50	408.61	425.55	440.60
IMPLL VAC	275.91	310.78	343.05	370.29	384.08	393.16	412.37	428.57	442.52	454.65
EPSILON	1.078	1.745	3.267	6.492	9.827	13.293	27.633	58.070	123.989	267.862
	COMPOSITION SHIFTING (MOL/100 GM)									
132.60 F	.0025	.0010	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000
-45.47 B*F	.9938	.9672	.9453	.9264	.9092	.8944	.8821	.8716	.8627	.8550
-143.00 B*F*O	.0112	.09105	1.0023	1.0862	1.1607	1.1990	1.2238	1.2715	1.2997	1.3123
-133.84 B*F2	.0377	.0276	.0203	.0153	.0119	.0106	.0098	.0087	.0077	.0068
-270.00 B*F3	.0035	.0033	.0033	.0037	.0047	.0060	.0077	.0112	.0157	.0204
114.76 B*F	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 B*F*O	.1273	.1174	.1044	.0891	.0708	.0593	.0510	.0325	.0196	.0132
-125.32 B*F*O2	.0270	.0274	.0259	.0228	.0182	.0150	.0127	.0076	.0042	.0026
66.00 B*F2	.0005	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.00 B*F2*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
16.00 B*F3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-236.60 B*F3*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 B*O	.1849	.1398	.0963	.0597	.0319	.0202	.0137	.0043	.0011	.0003
-84.00 B*O2	.0151	.0112	.0083	.0050	.0026	.0016	.0010	.0003	.0001	.0000
199.30 H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.60 B2*O2	.0045	.0041	.0036	.0030	.0022	.0018	.0015	.0008	.0004	.0003
-210.10 F2*O3	.0006	.0009	.0010	.0010	.0009	.0007	.0007	.0004	.0003	.0002
-567.00 H3*F3*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-541.69 F3*H3*O6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.0265	.0127	.0056	.0022	.0008	.0004	.0002	.0000	.0000	.0000
-64.50 F*O	.7492	.7113	.6630	.6104	.5581	.5287	.5079	.4546	.3776	.2669
-26.10 F*O*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.0947	.7476	.5936	.4415	.2996	.2254	.1772	.0836	.0342	.0129
9.33 F*O	.0369	.0200	.0096	.0040	.0014	.0006	.0003	.0001	.0000	.0000
.00 F2	1.0172	1.1337	1.2569	1.3816	1.5002	1.5649	1.6079	1.6981	1.7740	1.8456
-57.80 F2*O	.0572	.0488	.0391	.0291	.0199	.0151	.0120	.0062	.0028	.0012
59.56 O	.0175	.0073	.0026	.0007	.0002	.0001	.0000	.0000	.0000	.0000
.00 O2	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
34.10 O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

SYSTEM LIQUID HYDROPELLANT										PC 1000, PSIA		HEAT FORM		WT. Q/D	
COMPONENT										DENSITY		CM/CC		1000	
PC 1000										1.53		1.53		1.53	
200 2.00										0.62C		0.62C		0.62C	
200 2.00										0.62C		0.62C		0.62C	
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200 2.00										0.62C		0.62C		0.62C	
200 2.00										0.62C		0.62C			

PRESSURE PROFILE DATA

SYSTEM LIQUID BIPROPELLANT PC 100% PSIA

COMPONENT	TRCF FORMULA	DENSITY GM/CC	HEAT FORM (KCAL/ECRM.WT.)	WT. C/O
12H O+F2		1.53	+3.5	77.
29H H5+H9		0.620	+7.74	23.

BULK DENSITY = 1.144 GM/CC
MIXTURE RATIO = 3.348 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 246.11 EU/100GMS

CHAMBER													THROAT
FROZEN EXPANSION													
PRESSURE, PSIA	1000	392.1	152.5	63.10	25.12	14.70	10.00	5.981	1.585	.651	.251	.100	552.8
TEMP, DEG K	4224.7	3975.5	3265.7	2675.9	2186.0	1940.1	1779.3	1642.0	1462.7	932.4	743.2	588.4	4261.7
ENTHALPY (-)	-7.81	30.18	61.42	87.05	108.02	118.40	125.15	139.02	150.25	159.29	166.51	172.25	17.47
CP	.4475	.4425	.4373	.4314	.4245	.4200	.4162	.4069	.3971	.3870	.3768	.3665	.4444
IMPL OPT		181.79	245.41	277.26	317.44	351.36	380.07	397.40	370.22	341.27	319.43	303.79	148.31
IMPL VAC		271.19	299.80	325.54	345.59	355.29	361.46	373.49	383.84	391.27	397.23	401.87	265.78
EPSILON		1.057	1.615	2.840	5.274	7.665	10.066	19.497	35.060	74.563	146.174	286.204	1.000
SHIFTING EXPANSION													
PRESSURE, PSIA	1000	392.1	152.5	63.10	25.12	14.70	10.00	5.981	1.585	.651	.251	.100	572.2
TEMP, DEG K	4224.7	4494.2	4007.7	3658.7	3340.2	3167.0	3047.4	2774.0	2513.4	2265.9	2050.9	1878.5	4558.7
ENTHALPY (-)	-7.81	31.54	66.47	97.57	125.30	140.05	150.04	172.14	191.91	209.46	225.04	239.00	16.61
X BAR	4.724	4.604	4.489	4.382	4.284	4.230	4.194	4.114	4.044	3.983	3.920	3.851	4.652
N	4.724	4.604	4.489	4.382	4.284	4.230	4.194	4.114	4.044	3.983	3.920	3.851	4.652
CP	1.0149	1.7393	1.6220	1.4945	1.3665	1.2884	1.2305	1.0787	.9291	.8734	1.0067	1.2027	1.7743
IMPL OPT		185.01	254.20	302.77	340.29	358.65	370.59	395.70	416.85	434.75	450.08	463.37	145.74
IMPL VAC		279.54	315.32	346.55	376.64	390.25	400.41	420.63	437.91	452.70	465.32	476.67	271.54
EPSILON		1.000	1.756	5.300	6.583	9.975	13.561	28.445	60.504	129.346	279.657	613.930	1.000
COMPOSITION SHIFTING (MOL/100 GM)													
132.60 H	.0019	.0004	.0004	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0012
-45.47 F=F	.6444	.5867	.5360	.4944	.4626	.4472	.4374	.4165	.3966	.3701	.3252	.2842	.6087
-143.00 F=F+O	.F557	.9659	1.0664	1.1556	1.2315	1.2695	1.2940	1.3430	1.3787	1.4012	1.4124	1.4175	.9236
-133.84 F=F2	.C464	.C329	.0241	.0164	.0120	.C101	.C091	.0073	.C062	.0056	.0047	.0034	.0377
-270.00 F=F3	.C056	.C048	.0043	.0040	.0041	.0044	.0048	.0069	.0127	.0300	.0707	.1307	.0051
114.76 F=F	.C001	.C000	.0000	.0000	.C000	.C000	.C000	.0000	.0000	.0000	.C000	.C000	.0000
-47.12 F=F+O	.C524	.C471	.0422	.0371	.0315	.0279	.0252	.C186	.C123	.0074	.0043	.C027	.0492
-135.32 F=F+O2	.C187	.C201	.0207	.0203	.0185	.0164	.0153	.0112	.0072	.0041	.0024	.0016	.0196
26.00 F=F2	.C001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-45.00 F=F+O2	.C000	.C000	.0000	.0000	.0000	.0000	.0000	.C000	.C000	.0000	.C000	.C000	.0000
18.00 F=F3	.C000	.C000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 F=F3+O3	.C000	.C000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 F=O	.1678	.1366	.1051	.0750	.0484	.0355	.0275	.0132	.0051	.0015	.0004	.0001	.1489
-44.00 F=O2	.C037	.0220	.0187	.0142	.0095	.0069	.0053	.0025	.0009	.0002	.0001	.0000	.0228
199.30 H2	.C000	.C000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.60 H2+O2	.C015	.C013	.C011	.C009	.C007	.C006	.C005	.0003	.0002	.0001	.0000	.0000	.0013
-210.10 H2+O3	.0004	.0005	.0005	.0005	.0005	.0005	.0004	.0003	.0002	.0001	.0000	.0000	.0004
-567.00 H3=F3+O3	.C000	.C000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-541.69 H3=F3+O6	.C000	.C000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.1208	.0747	.0422	.0216	.0099	.C060	.C041	.0014	.0004	.0001	.0000	.0000	.0911
-64.50 F=H	1.1213	1.1442	1.1477	1.1351	1.1116	1.0956	1.0838	1.0556	1.0256	.9793	.8927	.7713	1.1375
-26.10 F=F+O	.C000	.C000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.C000	.0000
32.40 F=O	.C000	.C000	.0000	.0000	.0000	.0000	.0000	.0000	.C000	.C000	.0000	.0000	.0000
.00 F2	.C000	.C000	.0000	.0000	.0000	.0000	.C000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.9451	.8716	.7626	.6739	.5877	.4693	.4124	.2799	.1643	.0812	.0372	.0178	.9022
9.33 F=O	.C939	.0662	.0433	.0249	.0123	.0076	.0051	.0017	.0004	.0001	.0000	.0000	.0771
.00 F2	.4662	.5090	.5672	.6472	.7396	.7969	.8384	.9347	1.0212	1.0957	1.1665	1.2396	.4902
-57.80 F2+O	.C563	.C544	.0510	.0455	.0379	.0329	.0291	.0201	.0123	.0066	.0035	.0021	.0553
59.56 C	.1015	.0619	.0320	.0186	.0093	.0026	.0015	.0003	.0000	.0000	.0000	.0000	.0763
.00 C2	.C048	.C026	.C011	.C004	.C001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0033
34.10 C3	.C000	.C000	.0000	.0000	.0000	.0000	.C000	.C000	.0000	.0000	.0000	.0000	.0000

[illegible]

PRESSURE PROFILE DATA
 SYSTEM LIQUID HIPHOPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. C/O
 DEG K GM/CC (KCAL/FORM.WT.)
 128 B*F2 1.53 +3.5 40.
 298 B*H9 0.620 +7.74 20.

BULK DENSITY = 1.193 GM/CC
 MIXTURE RATIO = 4.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 277.41 EU/100GMS

CHAMBER

THREAT

	FROZEN EXPANSION									
PRESSURE, PSIA	1000	398.1	158.5	65.10	25.12	14.70	10.00	5.981	1.585	.641
TEMP, DEG K	4979.4	4086.6	3346.6	2733.8	2276.7	1972.8	1807.0	1460.1	1173.9	958.6
ENTHALPY (-)	-7.64	30.05	60.96	16.23	106.45	117.04	123.62	137.20	144.14	156.92
CP	.4242	.4199	.4150	.4090	.4031	.3990	.3956	.3864	.3776	.3682
IMPUL OPT	191.08	244.24	245.76	315.59	322.33	337.91	354.96	368.13	378.36	386.32
IMPUL VAC	269.48	248.25	323.45	343.39	352.92	358.98	371.17	380.69	388.13	393.93
EPSILON	1.056	1.610	2.424	5.232	7.593	9.961	19.246	37.475	73.231	143.206

	SHIFTING EXPANSION									
PRESSURE, PSIA	1000	398.1	158.5	65.10	25.12	14.70	10.00	5.981	1.585	.641
TEMP, DEG K	4979.4	4519.0	4189.6	3572.3	3552.3	3434.1	3266.9	2996.9	2739.7	2491.8
ENTHALPY (-)	-7.64	31.54	66.50	97.42	125.95	140.99	151.24	173.96	194.35	212.62
X PAR	4.557	4.429	4.310	4.201	4.100	4.045	4.008	3.924	3.849	3.783
N	4.557	4.429	4.310	4.201	4.100	4.045	4.008	3.924	3.849	3.783
CP	2.0722	2.0461	1.9521	1.8005	1.6120	1.4993	1.4185	1.2585	1.0710	.9044
IMPUL OPT	194.67	253.95	302.84	340.90	359.58	371.77	397.46	419.19	437.73	453.64
IMPUL VAC	279.16	215.42	349.14	377.64	392.49	402.21	423.64	440.93	456.35	469.62
EPSILON	1.082	1.767	3.339	6.694	10.202	13.869	29.265	62.446	134.413	249.874

	COMPOSITION SHIFTING (MOL/100 GMS)									
132.60 H	.0013	.0006	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000
-45.47 B*F	.4633	.4176	.3548	.2973	.2474	.2225	.2066	.1744	.1499	.1287
-143.00 B*F*O	.8320	.9477	1.0486	1.1376	1.2196	1.2607	1.2878	1.3440	1.3889	1.4236
-133.84 B*F2	.0510	.0356	.0240	.0158	.0102	.0079	.0066	.0044	.0032	.0024
-270.00 B*F3	.0078	.0066	.0055	.0045	.0037	.0034	.0033	.0033	.0034	.0034
114.76 B*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 B*H*O	.0269	.0229	.0195	.0168	.0144	.0132	.0123	.0101	.0078	.0054
-135.32 B*H*O2	.0127	.0136	.0146	.0155	.0164	.0166	.0166	.0157	.0133	.0099
66.00 B*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-49.00 B*H2*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 B*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 B*H3*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 B*O	.1337	.1112	.0896	.0693	.0504	.0404	.0336	.0199	.0100	.0040
-64.00 B*O2	.0253	.0255	.0247	.0228	.0196	.0170	.0150	.0098	.0052	.0022
199.30 H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.60 B2*O2	.0007	.0005	.0004	.0003	.0003	.0002	.0002	.0001	.0001	.0000
-210.10 B2*O3	.0002	.0003	.0003	.0003	.0003	.0004	.0004	.0003	.0003	.0001
-567.00 H3*F3*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-541.69 B3*H3*O6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.2408	.1716	.1152	.0715	.0402	.0272	.0200	.0086	.0032	.0010
-64.50 F*H	1.2743	1.3348	1.3800	1.4097	1.4243	1.4265	1.4255	1.4167	1.4027	1.3861
-26.10 F*H*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.6159	.7700	.7209	.6642	.5943	.5856	.5067	.4615	.2870	.0897
9.33 H*O	.1223	.0985	.0765	.0563	.0381	.0287	.0227	.0114	.0045	.0014
.00 H2	.2541	.2607	.2751	.2996	.3374	.3666	.3909	.4593	.5364	.6126
-57.80 H2*O	.0445	.0440	.0439	.0439	.0435	.0428	.0418	.0376	.0306	.0220
59.56 O	.2087	.1564	.1095	.0694	.0381	.0246	.0173	.0099	.0015	.0003
.00 O2	.0141	.0103	.0068	.0040	.0019	.0011	.0007	.0002	.0000	.0000
34.10 O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

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PRESSURE PROFILE DATA				
SYSTEM LIQUID BIPROPELLANT PC 1000 PSIA				
COMPONENT	INTL FORMULA	DENSITY	HEAT FORM	WT. C/O
	LEG K	GM/CC	(KCAL/FORM.WT.)	
12M	O*F2	1.53	+3.5	PP.
29M	B5*H9	0.62C	+7.74	12.

BULK DENSITY = 1.301 GM/CC
MIXTURE RATIO = 7.333 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
CHAMBER ENTROPY 249.73 EU/100GMS

CHAMBER											THROAT
FROZEN EXPANSION											
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251
TEMP, DEG K	4939.9	4002.5	3235.1	2607.5	2094.6	1740.5	1675.8	1534.5	1057.0	832.4	652.7
ENTHALPY (-)	-7.17	26.66	54.04	76.14	93.93	102.61	104.14	119.57	128.62	135.76	141.38
CP	.3628	.3569	.3545	.3495	.3436	.3395	.3364	.3298	.3221	.3151	.3083
IMPUL OPT	171.56	232.77	269.22	296.57	309.05	316.80	322.06	345.70	352.63	359.49	364.76
IMPUL VAC	255.23	281.04	303.96	321.90	330.41	335.77	346.47	354.73	361.10	366.00	369.77
EPSILON	1.052	1.548	2.756	5.049	7.277	9.499	18.127	34.846	67.214	129.793	250.512

SHIFTING EXPANSION											
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251
TEMP, DEG K	4939.9	4519.4	4139.2	3799.3	3490.4	3325.4	3213.9	2970.0	2754.2	2558.8	2374.9
ENTHALPY (-)	-7.17	28.15	59.56	87.57	112.61	125.95	135.04	155.18	173.36	189.82	204.76
X BAR	4.149	4.025	3.911	3.805	3.706	3.649	3.610	3.517	3.428	3.346	3.272
N	4.149	4.025	3.911	3.805	3.706	3.649	3.610	3.517	3.428	3.346	3.272
CP	1.7861	1.7277	1.6245	1.5213	1.4740	1.4837	1.5010	1.5497	1.5446	1.4367	1.2075
IMPUL OPT	175.31	240.94	287.09	322.61	340.32	351.73	375.82	396.30	413.98	429.38	442.89
IMPUL VAC	264.93	299.03	330.63	357.45	371.15	380.25	399.85	416.90	431.86	445.03	456.61
EPSILON	1.041	1.759	3.312	6.619	10.069	13.686	28.967	62.377	136.013	298.963	656.368

COMPOSITION SHIFTING (MOL/100 GM)											
132.60 F	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.47 B*F	.1227	.0016	.0491	.0262	.0124	.0077	.0053	.0022	.0009	.0003	.0001
-143.00 B*F*O	.6904	.7562	.8053	.8349	.8432	.8389	.8321	.8068	.7740	.7387	.7045
-123.84 B*F2	.0555	.0385	.0255	.0160	.0096	.0076	.0055	.0031	.0016	.0008	.0003
-270.00 B*F3	.0179	.0017	.0074	.0571	.0739	.0878	.0996	.1327	.1697	.2074	.2428
-114.76 B*F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 B*F*O	.0014	.0007	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-135.32 B*F*O2	.0022	.0018	.0013	.0009	.0006	.0004	.0003	.0002	.0001	.0001	.0001
66.00 B*F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.00 B*F2*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
10.00 B*F3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 B*F3*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 B*O	.0245	.0151	.0083	.0039	.0016	.0009	.0006	.0002	.0001	.0000	.0000
-84.00 B*O2	.0149	.0140	.0125	.0106	.0084	.0072	.0063	.0047	.0034	.0025	.0019
199.30 B2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.60 B2*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-210.10 B2*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-567.00 B3*F3*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-541.69 B3*F3*O6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.8605	.7685	.6624	.6008	.5214	.4748	.4409	.3580	.2746	.1941	.1201
-64.50 F*F	1.3603	1.4503	1.5291	1.5938	1.6412	1.6606	1.6712	1.6882	1.6974	1.7025	1.7069
-26.10 F*F*O	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F*O	.0004	.0002	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.1975	.1458	.0993	.0609	.0344	.0226	.0169	.0083	.0041	.0020	.0004
9.33 F*O	.0926	.0724	.0546	.0390	.0262	.0203	.0167	.0105	.0065	.0041	.0026
.00 F2	.0179	.0116	.0062	.0035	.0016	.0009	.0006	.0003	.0001	.0000	.0000
-57.80 F2*O	.0099	.0077	.0057	.0039	.0025	.0019	.0016	.0010	.0006	.0004	.0003
59.56 O	.5434	.4415	.4388	.3824	.3212	.2845	.2585	.2001	.1489	.1050	.0678
.00 O2	.1163	.1270	.1443	.1711	.2044	.2340	.2534	.3007	.3462	.3881	.4252
34.10 O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. G/O
 LEG. K GP/CC (KCAL/FORM.WT.)
 12R B=F2 1.52 +5.5 66.
 29R H5+H9 0.620 +7.74 34.

BULK DENSITY = 1.021 GM/CC
 MIXTURE RATIO = 1.941 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTRUPY 322.45 EU/100GMS

CHAMBER	FROZEN EXPANSION														THROAT
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	165.5		
TEMP, DEG K	3759.4	3185.7	2693.3	2271.5	1949.3	1710.1	1601.1	1356.9	1111.7	920.4	758.5	621.9	3424.7		
ENTHALPY (-)	-8.44	21.54	46.92	68.36	82.44	96.41	101.56	114.25	124.22	133.59	140.83	146.79	14.31		
CP	.5260	.5192	.5119	.5036	.4972	.4931	.4854	.4745	.4638	.4529	.4417	.4301	.5206		
IMPUL OPT	161.50	219.47	258.49	281.25	297.26	309.36	326.71	340.49	351.51	360.37	367.49	373.45	251.80		
IMPUL VAC	254.25	277.17	299.80	314.51	318.53	314.69	345.95	355.84	363.23	370.27	375.45	375.45	251.80		
EPSILON	1.025	1.421	2.265	3.370	3.817	6.617	11.651	20.701	36.971	66.184	118.509	1.000			
CHAMBER	SHIFTING EXPANSION														THROAT
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	171.3		
TEMP, DEG K	3759.4	3437.6	3145.3	2872.9	2671.1	2610.3	2347.4	2077.0	1805.3	1572.7	1476.4	1384.3	3540.5		
ENTHALPY (-)	-8.44	22.36	50.00	74.84	92.16	97.14	117.07	134.73	150.15	163.46	175.42	186.43	13.48		
X BAR	5.439	5.330	5.232	5.148	5.094	5.080	5.030	5.002	4.990	4.971	4.985	4.996	5.361		
N	5.439	5.330	5.232	5.148	5.094	5.080	5.030	5.002	4.990	4.971	4.985	4.996	5.361		
CP	1.5103	1.4276	1.3660	1.3145	1.0060	.9612	.7763	.6269	.5467	2.0595	1.4502	2.2683	1.4560		
IMPUL OPT	163.69	225.48	269.17	295.44	303.07	330.45	352.92	371.44	386.72	399.94	411.75	418.09			
IMPUL VAC	260.46	282.58	316.67	335.60	340.89	361.34	378.37	392.41	404.19	415.53	425.73	425.73	256.54		
EPSILON	1.038	1.508	2.528	3.911	4.443	8.153	14.957	27.442	50.941	101.192	202.088	1.000			
COMPOSITION SHIFTING (MOL/100 GM)															
132.60 B	.0024	.0011	.0004	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0014		
-45.47 B=F	1.5178	1.5132	1.5084	1.5035	1.4998	1.4927	1.4942	1.4904	1.4878	1.4937	1.5434	1.5687	1.5146		
-143.00 B=F+O	.6305	.6908	.7476	.8000	.8365	.8470	.8873	.9183	.9334	.9224	.8380	.7266	.6730		
-133.84 B=F2	.0129	.0092	.0064	.0044	.0033	.0030	.0020	.0013	.0008	.0005	.0005	.0005	.0102		
-270.00 B=F3	.0007	.0006	.0006	.0005	.0005	.0006	.0007	.0011	.0024	.0069	.0178	.0446	.0006		
114.76 F+H	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001		
-47.13 B+H+O	.2625	.2582	.2508	.2401	.2294	.2225	.2063	.1817	.1525	.1181	.0657	.0454	.2598		
-135.32 B+H+O2	.0260	.0265	.0261	.0248	.0231	.0225	.0190	.0147	.0099	.0057	.0024	.0009	.0264		
64.00 B+H2	.0010	.0005	.0002	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0006		
-45.00 B+H2+O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
18.00 B+H3	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
-238.40 B+H3+O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
5.74 B+O	.1968	.1443	.1047	.0674	.0438	.0376	.0167	.0051	.0010	.0001	.0000	.0000	.1624		
-84.00 B+O2	.0068	.0031	.0035	.0022	.0013	.0011	.0004	.0001	.0000	.0000	.0000	.0000	.0058		
199.30 B2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
-111.60 B2+O2	.0152	.0167	.0185	.0205	.0224	.0230	.0263	.0311	.0387	.0443	.0189	.0077	.0163		
-210.10 B2+O3	.0016	.0020	.0026	.0034	.0041	.0044	.0058	.0081	.0119	.0157	.0064	.0024	.0019		
-567.00 B3+F3+O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
-541.69 B3+F3+O6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
18.66 F	.0022	.0003	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
-64.50 F+H	.2661	.2195	.1737	.1304	.0998	.0810	.0569	.0299	.0124	.0047	.0041	.0035	.2335		
-26.10 F+H+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
32.40 F+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
52.10 F	.6573	.5325	.3828	.2523	.1679	.1454	.0675	.0222	.0046	.0008	.0004	.0002	.5804		
9.33 F+O	.0055	.0025	.0010	.0003	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0032		
.00 F2	1.7671	1.8826	1.9906	2.0886	2.1554	2.1740	2.2443	2.2966	2.3319	2.3573	2.3856	2.4019	1.8487		
-57.80 F2+O	.0250	.0192	.0138	.0092	.0063	.0055	.0028	.0011	.0003	.0001	.0000	.0000	.0209		
59.56 O	.0012	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0006		
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
34.10 O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
-305.34 B2+O3/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0109	.0841	.1416	.0000	

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/D
 (EG K) (GM/CC) (KCAL/FORM.WT.)
 12H O+F2 1.53 +3.5 72.
 29H H5+H9 0.620 +7.74 28.
 BULK DENSITY = 1.084 GM/CC
 MIXTURE RATIO = 2.571 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 310.74 EU/100GMS

CHAMBER												THROAT
FROZEN EXPANSION												
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050
TEMP, DEG K	4210.4	3501.3	2904.4	2403.4	2198.2	1983.3	1630.5	1334.8	1087.6	881.8	711.0	569.9
ENTHALPY (-)	-8.10	26.04	54.40	77.90	87.44	97.32	113.31	126.44	137.16	145.87	152.92	158.59
CP	.4842	.4744	.4723	.4655	.4619	.4577	.4486	.4347	.4285	.4180	.4070	.3960
IMPUL GPT	172.34	233.18	273.53	288.29	302.83	325.00	342.11	355.48	365.99	374.27	380.80	384.42
IMPUL VAC	262.53	288.48	312.54	322.14	331.91	347.27	359.43	369.06	376.69	382.71	387.45	390.57
EPSILON	1.042	1.524	2.566	3.343	4.365	5.347	6.347	7.347	8.347	9.347	10.347	11.347
SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050
TEMP, DEG K	4210.4	3501.3	2904.4	2403.4	2198.2	1983.3	1630.5	1334.8	1087.6	881.8	711.0	569.9
ENTHALPY (-)	-8.10	26.04	54.40	77.90	87.44	97.32	113.31	126.44	137.16	145.87	152.92	158.59
X BAR	5.135	5.009	4.891	4.782	4.715	4.684	4.597	4.524	4.465	4.412	4.353	4.293
N	5.135	5.009	4.891	4.782	4.715	4.684	4.597	4.524	4.465	4.412	4.353	4.293
CP	1.7587	1.7100	1.6424	1.5440	1.4842	1.4034	1.2186	1.0086	.8440	.6872	.5310	.4650
IMPUL GPT	175.18	240.97	287.37	305.21	323.40	342.68	377.04	397.56	414.94	429.62	442.75	454.06
IMPUL VAC	270.16	302.70	333.79	346.78	360.48	383.25	402.68	419.23	433.37	445.72	456.62	466.09
EPSILON	1.061	1.645	2.953	3.971	5.630	7.079	8.2180	9.4734	10.7474	12.0394	13.3438	14.6500
COMPOSITION SHIFTING (MOL/100 GM)												
172.6C B	.0020	.0009	.0004	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0012
-45.47 B+F	.9937	.9962	.9949	.9929	.9929	.9935	.9908	.9887	.9876	.9858	.9835	.9752
-145.0C B+F+C	.0017	.0035	1.0171	1.0924	1.1246	1.1589	1.2158	1.2619	1.2950	1.3135	1.3213	1.3243
-133.84 B+F2	.0245	.0179	.0133	.0100	.0088	.0078	.0063	.0055	.0051	.0048	.0038	.0025
-270.0C B+F3	.0020	.0018	.0018	.0018	.0019	.0021	.0029	.0050	.0126	.0383	.0877	.1441
114.76 B+F	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 B+F+C	.0131	.0550	.0667	.0760	.0762	.0631	.0488	.0341	.0209	.0120	.0079	.0062
-135.32 B+F+C2	.0217	.0222	.0213	.0192	.0174	.0160	.0121	.0080	.0045	.0023	.0014	.0010
-66.0C B+F2	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-45.0C B+F2+C2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.0C B+F3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.6C B+F3+C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 B+C	.0247	.1576	.1139	.0760	.0609	.0457	.0237	.0098	.0029	.0007	.0002	.0001
-84.0C B+C2	.0163	.0130	.0095	.0063	.0050	.0037	.0018	.0007	.0002	.0000	.0000	.0000
199.3C B2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.6C B2+C2	.0034	.0032	.0029	.0024	.0022	.0019	.0014	.0008	.0004	.0002	.0001	.0001
-210.1C B2+C3	.0006	.0007	.0008	.0008	.0008	.0007	.0006	.0004	.0002	.0001	.0001	.0001
-567.0C B2+F2+C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-541.6C B2+F2+C6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.0281	.0142	.0067	.0030	.0020	.0012	.0004	.0001	.0000	.0000	.0000	.0000
-64.5C F+F	.7483	.7114	.6662	.6180	.5958	.5712	.5284	.4899	.4499	.4048	.3612	.3173
-26.1C F+F+C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.4C F+C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.0C F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.1C F	1.0975	.9417	.7776	.6128	.5375	.4539	.3073	.1808	.0859	.0335	.0128	.0047
9.33 F+C	.0343	.0197	.0102	.0047	.0032	.0019	.0006	.0002	.0000	.0000	.0000	.0000
.0C F2	.9986	1.0610	1.1818	1.3045	1.3668	1.4235	1.5339	1.6310	1.7104	1.7767	1.8423	1.9047
-57.8C F2+C	.0042	.0385	.0318	.0247	.0215	.0179	.0120	.0071	.0036	.0016	.0007	.0003
59.56 C	.0217	.0097	.0038	.0013	.0007	.0003	.0001	.0000	.0000	.0000	.0000	.0000
.0C F2	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
34.1C C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

SYSTEM LIQUID PROPPELLANT	COMPONENT	CEG K	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K	128 80F2	PC 300. PSIA	DENSITY	HEAT FORM...	MT. B/B			
	CEG K								

PRESSURE PROFILE DATA
 SYSTEM LIQUID PROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 128 O*F2 1.53 +3.5 77.
 298 H5*H9 0.620 +7.74 23.

BULK DENSITY = 1.144 GM/CC
 MIXTURE RATIO = 3.348 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 297.57 EU/100GMS

CHAMBER	FROZEN EXPANSION										SHIFTING EXPANSION															
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	165.2	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	172.0
TEMP, DEG K	4534.2	3753.9	3101.5	2556.3	2333.7	2101.4	1721.5	1404.8	1141.1	922.4	741.7	593.1	3983.9	4534.2	4173.3	3847.9	3550.7	3420.1	3277.2	3025.0	2790.6	2569.0	2353.9	2142.5	1951.1	4298.8
ENTHALPY (-)	-7.81	26.86	55.54	79.21	88.79	98.69	114.69	127.76	138.41	147.04	154.00	159.57	16.68	-7.81	28.21	60.55	89.65	102.24	115.88	139.54	160.91	180.23	197.64	213.30	227.34	15.69
X BAR	4.853	4.726	4.608	4.497	4.448	4.394	4.298	4.209	4.129	4.060	4.000	3.942	4.771	4.853	4.726	4.608	4.497	4.448	4.394	4.298	4.209	4.129	4.060	4.000	3.942	4.771
N	4.853	4.726	4.608	4.497	4.448	4.394	4.298	4.209	4.129	4.060	4.000	3.942	4.771	4.853	4.726	4.608	4.497	4.448	4.394	4.298	4.209	4.129	4.060	4.000	3.942	4.771
CP	2.1379	2.0462	1.9161	1.7772	1.7152	1.6477	1.5195	1.3727	1.1937	1.0048	.8904	.9955	2.0850	2.1379	2.0462	1.9161	1.7772	1.7152	1.6477	1.5195	1.3727	1.1937	1.0048	.8904	.9955	2.0850
IMPLL OPT	173.68	234.76	275.15	289.89	304.39	326.44	343.42	356.66	367.03	375.19	381.60	385.97		173.68	234.76	275.15	289.89	304.39	326.44	343.42	356.66	367.03	375.19	381.60	385.97	
IMPLL VAC	264.37	290.19	314.13	323.66	333.36	348.57	360.59	370.08	377.57	383.48	388.12	390.49		264.37	290.19	314.13	323.66	333.36	348.57	360.59	370.08	377.57	383.48	388.12	390.49	
EPSILON	1.041	1.518	2.548	3.315	4.519	8.239	15.255	28.478	53.392	100.239	188.092	1.000		1.041	1.518	2.548	3.315	4.519	8.239	15.255	28.478	53.392	100.239	188.092	1.000	

COMPOSITION SHIFTING (MOL/100 GM)																										
132.60 H	.0015	.0007	.0003	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0009	.0015	.0007	.0003	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0009
-45.47 H*F	.6515	.5914	.5391	.4969	.4807	.4648	.4411	.4233	.4092	.3962	.3784	.3632	.6122	.6515	.5914	.5391	.4969	.4807	.4648	.4411	.4233	.4092	.3962	.3784	.3632	.6122
-143.00 E*F*O	.8769	.9814	1.0767	1.1605	1.1954	1.2318	1.2900	1.3359	1.3705	1.3948	1.4100	1.4177	.9447	.8769	.9814	1.0767	1.1605	1.1954	1.2318	1.2900	1.3359	1.3705	1.3948	1.4100	1.4177	.9447
-133.84 E*F2	.0313	.0223	.0158	.0113	.0097	.0082	.0062	.0049	.0041	.0036	.0031	.0031	.0253	.0313	.0223	.0158	.0113	.0097	.0082	.0062	.0049	.0041	.0036	.0031	.0031	.0253
-270.00 E*F3	.0034	.0029	.0025	.0023	.0022	.0022	.0024	.0029	.0042	.0079	.0196	.0518	.0031	.0034	.0029	.0025	.0023	.0022	.0022	.0024	.0029	.0042	.0079	.0196	.0518	.0031
114.76 E*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-47.13 E*H*O	.0369	.0354	.0322	.0290	.0274	.0255	.0214	.0170	.0124	.0083	.0049	.0028	.0366	.0369	.0354	.0322	.0290	.0274	.0255	.0214	.0170	.0124	.0083	.0049	.0028	.0366
-135.32 E*H*O2	.0137	.0148	.0155	.0156	.0153	.0147	.0128	.0101	.0072	.0045	.0025	.0014	.0144	.0137	.0148	.0155	.0156	.0153	.0147	.0128	.0101	.0072	.0045	.0025	.0014	.0144
66.00 E*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-45.00 E*H2*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
18.00 E*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-238.60 E*H3*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
5.74 E*O	.1767	.1465	.1161	.0868	.0739	.0601	.0379	.0213	.0103	.0040	.0012	.0003	.1574	.1767	.1465	.1161	.0868	.0739	.0601	.0379	.0213	.0103	.0040	.0012	.0003	.1574
-84.00 E*O2	.0239	.0226	.0199	.0159	.0138	.0114	.0072	.0039	.0018	.0006	.0002	.0000	.0232	.0239	.0226	.0199	.0159	.0138	.0114	.0072	.0039	.0018	.0006	.0002	.0000	.0232
199.30 E2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-111.60 E2*O2	.0010	.0009	.0008	.0006	.0006	.0005	.0004	.0003	.0002	.0001	.0000	.0000	.0009	.0010	.0009	.0008	.0006	.0006	.0005	.0004	.0003	.0002	.0001	.0000	.0000	.0009
-210.10 E2*O3	.0003	.0003	.0004	.0004	.0004	.0004	.0003	.0003	.0002	.0001	.0001	.0000	.0003	.0003	.0003	.0004	.0004	.0004	.0004	.0003	.0003	.0002	.0001	.0001	.0000	.0003
-567.00 E3*F3*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-541.69 E3*H3*O6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
18.86 F	.1315	.0844	.0502	.0274	.0201	.0138	.0063	.0027	.0010	.0003	.0001	.0000	.0998	.1315	.0844	.0502	.0274	.0201	.0138	.0063	.0027	.0010	.0003	.0001	.0000	.0998
-64.50 F*H	1.1193	1.1413	1.1467	1.1377	1.1297	1.1186	1.0950	1.0715	1.0503	1.0295	.9978	.9295	1.1353	1.1193	1.1413	1.1467	1.1377	1.1297	1.1186	1.0950	1.0715	1.0503	1.0295	.9978	.9295	1.1353
-26.10 F*H*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
32.40 F*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
52.10 F	1.1243	1.0522	.9658	.8597	.8031	.7336	.5929	.4475	.3076	.1848	.0928	.0420	1.0795	1.1243	1.0522	.9658	.8597	.8031	.7336	.5929	.4475	.3076	.1848	.0928	.0420	1.0795
9.33 F*O	.0829	.0613	.0420	.0260	.0200	.0143	.0069	.0028	.0010	.0003	.0000	.0000	.0689	.0829	.0613	.0420	.0260	.0200	.0143	.0069	.0028	.0010	.0003	.0000	.0000	.0689
.00 F2	.4086	.4465	.4596	.5696	.6078	.6548	.7492	.8454	.9365	1.0170	1.0852	1.1485	.4313	.4086	.4465	.4596	.5696	.6078	.6548	.7492	.8454	.9365	1.0170	1.0852	1.1485	.4313
-57.80 F2*O	.0401	.0394	.0377	.0347	.0328	.0303	.0246	.0185	.0126	.0077	.0041	.0021	.0397	.0401	.0394	.0377	.0347	.0328	.0303	.0246	.0185	.0126	.0077	.0041	.0021	.0397
59.56 O	.1228	.0790	.0451	.0223	.0152	.0093	.0032	.0009	.0002	.0000	.0000	.0000	.0937	.1228	.0790	.0451	.0223	.0152	.0093	.0032	.0009	.0002	.0000	.0000	.0000	.0937
.00 O2	.0047	.0027	.0013	.0005	.0003	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0034	.0047	.0027	.0013	.0005	.0003	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0034
34.10 O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	

SYSTEM LIQUID BIPROPELLANT										PC 300. PSIA		DENSITY		HEAT FORM		WT. O/D	
COMPONENT										TREF FORMULA		GM/CC		(KCAL/FORM.WT.)		77.23	
										DEG K		1.33		+3.5			
										128 DPF2		0.620		+7.74			
										298 B59HH							
										C STAR = 6692.9 FT/SEC							
										FROZEN EXPANSION							
										CP CAL/I		OPT DEL VAC		I SEA		I AT	
										GM DEG		DEL VAC		LVL 10000		I VAC	
																CF SEA	
																CF VAC	

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 128 O*F2 1.53 +3.5 80.
 298 B5*H9 0.620 +7.74 20.

PULK DENSITY = 1.183 GM/CC
 MIXTURE RATIO = 4.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 288.46 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	164.0
TEMP, DEG K	4665.6	3851.0	3172.3	2607.0	2376.7	2136.8	1745.4	1420.2	1150.2	927.1	743.3	592.9	4084.5
ENTHALPY (-)	-7.64	26.69	55.00	78.30	87.70	97.41	113.06	125.81	136.17	144.54	151.27	156.65	16.89
CP	.4235	.4193	.4147	.4094	.4067	.4033	.3959	.3878	.3793	.3705	.3618	.3531	.4206
IMPLV OPT	172.81	233.43	273.42	287.58	302.30	324.03	340.73	353.70	363.85	371.81	378.05	384.07	146.07
IMPLV VAC	262.91	288.37	311.97	321.35	330.88	345.81	357.58	366.85	374.15	379.89	384.39	389.12	259.12
EPSILON	1.040	1.513	2.534	3.293	4.484	8.155	15.061	28.048	52.452	98.232	183.903	1.000	
	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	173.0
TEMP, DEG K	4665.6	4318.1	4008.4	3727.2	3603.5	3467.2	3222.9	2991.2	2770.6	2560.0	2356.2	2153.1	4440.7
ENTHALPY (-)	-7.64	28.15	60.42	89.63	102.34	116.14	140.23	162.10	181.95	199.97	216.27	230.99	15.44
X BAR	4.677	4.547	4.427	4.316	4.267	4.213	4.118	4.029	3.947	3.872	3.805	3.749	4.593
N	4.677	4.547	4.427	4.316	4.267	4.213	4.118	4.029	3.947	3.872	3.805	3.749	4.593
CP	2.4509	2.4176	2.3119	2.1482	2.0579	1.9485	1.7416	1.5486	1.3773	1.2069	1.0219	.8394	2.4413
IMPLV OPT	176.44	243.33	290.90	309.31	328.15	358.66	384.26	406.12	424.98	441.35	455.63	461.68	
IMPLV VAC	272.64	306.37	338.70	352.29	366.64	390.65	411.38	429.40	445.14	458.91	470.94	476.15	
EPSILON	1.064	1.664	3.012	4.065	5.787	11.482	23.228	47.597	98.399	204.562	425.832	1.000	
	COMPOSITION SHIFTING (MOL/100 GM)												
132.60 E	.0010	.0005	.0002	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0007
-45.47 E*F	.4980	.4313	.3679	.3096	.2845	.2580	.2149	.1814	.1563	.1375	.1223	.1082	.4555
-143.00 E*F*O	.8514	.9536	1.0487	1.1353	1.1727	1.2125	1.2793	1.3347	1.3791	1.4136	1.4395	1.4580	.9168
-133.84 E*F2	.0353	.0250	.0171	.0114	.0094	.0075	.0049	.0032	.0022	.0016	.0013	.0011	.0285
-270.00 E*F3	.0049	.0042	.0034	.0028	.0025	.0022	.0019	.0017	.0017	.0021	.0033	.0069	.0044
114.76 E*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 E*H*O	.0194	.0166	.0143	.0124	.0117	.0109	.0095	.0082	.0068	.0053	.0038	.0024	.0176
-135.32 E*H*O2	.0088	.0094	.0101	.0108	.0111	.0116	.0122	.0122	.0113	.0094	.0069	.0044	.0092
66.00 E*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.00 E*H2*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 E*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 E*H3*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 E*O	.1385	.1166	.0958	.0764	.0678	.0584	.0420	.0278	.0165	.0085	.0036	.0012	.1245
-84.00 E*O2	.0244	.0248	.0244	.0232	.0223	.0210	.0175	.0130	.0083	.0044	.0019	.0006	.0247
199.30 E2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.60 E2*O2	.0005	.0004	.0003	.0002	.0002	.0002	.0002	.0001	.0001	.0001	.0000	.0000	.0004
-210.10 E2*O3	.0002	.0002	.0002	.0002	.0002	.0002	.0003	.0003	.0002	.0002	.0001	.0001	.0002
-567.00 E3*F3*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-541.69 E3*H3*O6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.2631	.1935	.1355	.0891	.0713	.0541	.0297	.0146	.0064	.0025	.0008	.0002	.2177
-64.50 F*H	1.2652	1.3221	1.3663	1.3978	1.4082	1.4167	1.4237	1.4208	1.4115	1.3998	1.3878	1.3735	1.3028
-26.10 F*H*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.9572	.9113	.8640	.8112	.7833	.7480	.6691	.5708	.4557	.3329	.2151	.1159	.9281
9.33 F*O	.1036	.0854	.0686	.0530	.0462	.0387	.0259	.0152	.0076	.0031	.0010	.0002	.0919
.00 F2	.2175	.2224	.2332	.2518	.2639	.2810	.3237	.3815	.4518	.5281	.6021	.6670	.2200
-57.80 F2*O	.0300	.0299	.0299	.0303	.0305	.0307	.0308	.0296	.0264	.0213	.0153	.0095	.0299
59.56 O	.2444	.1899	.1400	.0957	.0775	.0589	.0312	.0136	.0047	.0012	.0002	.0000	.2095
.00 O2	.0131	.0099	.0070	.0045	.0035	.0026	.0012	.0004	.0001	.0000	.0000	.0000	.0111
34.10 O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

SYSTEM LIQUID BIPROPELLANT										PC 100, PSIA		DENSITY		HEAT FORM		WT. 0/0	
COMPONENT										TREF FORMULA		GM/GC		(KCAL/FORM.WT.)		8C.	
										DEG R		1.53		1.53		20.	
										1218 84F2		0.620		47.74			
										258 854M9							

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 128 O=F2 1.53 +3.5 88.
 298 H5=H9 0.620 +7.74 12.

PULK DENSITY = 1.301 GM/CC
 MIXTURE RATIO = 7.333 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 259.77 EU/100GMS

	CHAMBER										THROAT															
	FROZEN EXPANSION																									
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	163.8													
TEMP, DEG K	4635.4	3781.4	3077.7	2498.3	2264.2	2021.7	1630.0	1308.5	1045.5	831.3	658.0	518.4	4023.9													
ENTHALPY (-)	-7.17	23.59	48.65	69.03	77.18	85.55	98.89	109.63	118.23	125.08	130.52	134.82	14.89													
CP	.3621	.3583	.3540	.3492	.3467	.3435	.3372	.3304	.3234	.3168	.3106	.3047	.3595													
IMPL OPT	163.59	220.38	257.48	270.89	284.01	303.76	318.77	330.29	339.20	346.11	351.46	358.53														
IMPL VAC	248.36	271.60	293.07	301.55	310.12	323.44	333.82	341.90	348.19	353.08	356.87	245.05														
EPSILON	1.037	1.495	2.470	3.207	4.342	7.812	14.263	26.251	48.513	89.820	166.330	1.000														

	SHIFTING EXPANSION																								
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	172.6												
TEMP, DEG K	4635.4	4284.7	3965.2	3679.2	3550.8	3409.3	3160.3	2936.4	2738.7	2563.3	2404.3	2255.0	4407.8												
ENTHALPY (-)	-7.17	25.04	54.00	80.12	91.44	103.71	125.03	144.33	161.86	177.86	192.49	205.92	13.70												
X BAR	4.242	4.119	4.005	3.900	3.854	3.803	3.710	3.620	3.533	3.449	3.371	3.299	4.162												
N	4.242	4.119	4.005	3.900	3.854	3.803	3.710	3.620	3.533	3.449	3.371	3.299	4.162												
CP	2.0932	2.0130	1.8715	1.7043	1.6346	1.5762	1.5494	1.6208	1.7143	1.7470	1.6670	1.4620	2.0534												
IMPL OPT	167.40	230.69	275.57	292.89	310.58	339.13	363.04	383.48	401.21	416.77	430.55	134.76													
IMPL VAC	258.54	290.26	320.59	333.29	346.67	369.02	388.36	405.29	420.26	433.58	445.49	252.46													
EPSILON	1.063	1.659	2.991	4.030	5.724	11.315	22.872	47.039	98.058	206.526	437.975	1.000													

COMPOSITION SHIFTING (MOL/100 GM)

132.60 F	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.47 F=F	.1373	.0950	.0803	.0344	.0254	.0174	.0079	.0034	.0014	.0006	.0002	.0001	.1096
-143.00 F=F+O	.7048	.7680	.8179	.8524	.8628	.8698	.8692	.8524	.8245	.7909	.7555	.7210	.7464
-133.84 F=F2	.0404	.0287	.0196	.0128	.0104	.0081	.0049	.0029	.0017	.0009	.0005	.0002	.0327
-270.00 F=F3	.0240	.0259	.0288	.0338	.0375	.0432	.0601	.0858	.1185	.1548	.1917	.2270	.0252
114.76 F=H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 F=H+O	.0011	.0006	.0003	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0008
-135.32 F=H+O2	.0015	.0012	.0009	.0007	.0006	.0004	.0003	.0002	.0001	.0001	.0000	.0000	.0013
66.00 F=H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.00 F=H2+O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 F=H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 F=H3+O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 F=O	.0265	.0171	.0100	.0051	.0036	.0023	.0009	.0003	.0001	.0000	.0000	.0000	.0203
-84.00 F=O2	.0140	.0132	.0120	.0104	.0096	.0085	.0065	.0048	.0035	.0025	.0019	.0014	.0135
149.30 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.60 F2+O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-210.10 F2+O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-567.00 F3+F3+O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-541.69 F3+H3+O6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.9175	.8291	.7468	.6701	.6360	.5982	.5279	.4551	.3783	.2996	.2224	.1497	.8605
-64.50 F=H	1.3465	1.4318	1.5087	1.5753	1.6019	1.6280	1.6441	1.6580	1.6691	1.7020	1.7051	1.7069	1.4017
-26.10 F=H+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F=O	.0002	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
.00 F2	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.2356	.1833	.1313	.0855	.0672	.0494	.0256	.0126	.0062	.0031	.0016	.0008	.2033
9.33 F=H	.0753	.0602	.0468	.0347	.0296	.0242	.0158	.0099	.0061	.0039	.0025	.0016	.0655
.00 F2	.0162	.0110	.0068	.0038	.0027	.0018	.0007	.0003	.0001	.0000	.0000	.0000	.0128
-57.80 F2+O	.0066	.0052	.0040	.0029	.0024	.0019	.0012	.0007	.0004	.0003	.0002	.0001	.0057
59.56 C	.5965	.5465	.4968	.4442	.4177	.3855	.3210	.2572	.2002	.1514	.1104	.0755	.5646
.00 C2	.0938	.1015	.1139	.1340	.1466	.1639	.2039	.2496	.2956	.3390	.3786	.4143	.0982
34.10 C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

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Ford Motor Company,
AERONUTRONIC DIVISION

OF₂ - N₂H₄ SYSTEM

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA

COMPONENT	TREF FORMULA DEG K	DENSITY GM/CC	HEAT FORM (KCAL/FORM.WT.)	WT. 0/0
128	O ₂ F ₂	1.53	3.5	44.
298	N ₂ O ₄	1.004	12.05	56.

BULK DENSITY = 1.183 GM/CC
MIXTURE RATIO = .786 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 330.95 EU/100GMS

CHAMBER													THRUST
FROZEN EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	16.70	10.00	3.981	1.585	.631	.251	.100	546.4
TEMP, DEG K	3421.8	2808.6	2292.9	1859.4	1495.5	1311.7	1191.3	939.6	734.7	570.6	441.2	340.8	3009.9
ENTHALPY (-)	-23.91	11.24	40.02	63.44	82.36	91.59	97.51	109.52	118.95	126.30	132.00	136.38	-2.20
CP	.5799	.5657	.5492	.5301	.5087	.4957	.4867	.4676	.4530	.4433	.4381	.4346	.5707
IMPUL OPT	174.86	235.82	275.66	304.05	316.98	325.00	340.69	352.53	361.49	368.28	373.42	374.60	143.60
IMPUL VAC	260.70	287.79	311.71	330.34	339.10	344.59	355.43	363.67	369.92	374.69	378.30	378.30	255.62
EPSILON	1.056	1.605	2.797	5.123	7.368	9.591	18.127	34.405	65.457	124.791	238.793	1.000	
SHIFTING EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	16.70	10.00	3.981	1.585	.631	.251	.100	559.7
TEMP, DEG K	3421.8	2951.4	2489.5	2052.9	1667.1	1489.5	1339.4	1065.3	839.3	656.1	510.5	400.7	3124.4
ENTHALPY (-)	-23.91	11.92	42.21	67.38	87.95	98.06	104.56	117.84	128.36	136.61	143.05	148.05	-1.67
X BAR	6.182	6.108	6.070	6.059	6.057	6.057	6.057	6.057	6.057	6.057	6.055	6.034	6.131
N	6.182	6.108	6.070	6.059	6.057	6.057	6.057	6.057	6.057	6.057	6.055	6.034	6.131
CP	.9559	.7649	.6248	.5518	.5187	.5045	.4951	.4742	.4570	.4451	.4432	.5248	.8322
IMPUL OPT	176.53	239.63	281.81	311.94	325.73	334.30	351.16	363.96	373.69	381.10	386.78	142.17	
IMPUL VAC	264.81	294.30	319.96	339.93	349.36	355.28	367.05	376.03	382.88	388.12	392.18	258.65	
EPSILON	1.066	1.652	2.906	5.353	7.724	10.081	19.173	36.609	70.010	134.125	259.660	1.000	
COMPOSITION SHIFTING (MOL/100 GM)													
18.86 F	.0024	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0010
-64.50 F=H	1.6272	1.6291	1.6296	1.6296	1.6296	1.6296	1.6296	1.6296	1.6296	1.6296	1.6296	1.6296	1.6287
-26.10 F=H=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
58.60 F=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-15.70 F=N=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.1981	.0868	.0244	.0037	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.1227
79.20 H=N	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-10.00 H=N=O	.0015	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0008
9.33 H=O	.0390	.0126	.0023	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0203
.00 H2	1.7955	1.8301	1.8542	1.8633	1.8649	1.8651	1.8651	1.8650	1.8650	1.8645	1.8615	1.8311	1.8178
40.30 H2=N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2=O	.7660	.8000	.8123	.8146	.8148	.8148	.8148	.8148	.8148	.8148	.8148	.8148	.7905
-11.04 H3=N	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0001	.0001	.0004	.0024	.0227	.0001
113.00 N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
21.65 N=O	.0051	.0012	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0022
8.06 N=O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	1.7439	1.7465	1.7472	1.7474	1.7474	1.7474	1.7474	1.7474	1.7473	1.7472	1.7462	1.7360	1.7458
19.50 N2=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.0025	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0008
.00 O2	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001

SYSTEM LIQUID BIPROPELLANT PC 1000, PSIA

COMPONENT		TREF FORMULA	DENSITY	HEAT FURN	WT. O/F									
		DEG K	ORICE	(KCAL/POUND.WT.)										
		120 00F2	1.53	3.5	44.									
		290 N2+H4	1.004	12.05	56.									
FROZEN EXPANSION														
C STAR = 6571.7 FT/SEC														
EPSILON	PC/P	P PSIA	TEMP DEG K	ENTHALPY DEG K	CP CAL/ GH DEG	I OPT DELVAC /P	I SEA LVL	I AT 10000	I AT 50000	I VAC	CF SEA LVL	CF VAC		
1.000	1.000	1000.000	3421.8	23.91	.580	.871	143.6	112.0	.204	252.6	253.5	253.5	1.237	1.251
2.000	1.023	94.818	2096.4	-20	.571	255.6	43.0	.430	292.2	294.1	297.8	298.5	1.431	1.462
3.000	17.930	56.086	1812.4	-65.93	.528	279.6	34.6	.417	305.1	307.9	313.2	314.2	1.496	1.538
4.000	28.207	35.452	1635.6	-75.28	.518	293.8	29.6	.436	311.2	316.9	322.0	323.5	1.523	1.584
5.000	36.551	25.939	1508.6	-81.70	.510	303.1	24.6	.425	316.6	319.2	328.8	329.7	1.540	1.614
6.000	50.492	19.605	1412.4	-86.54	.503	310.0	20.4	.420	316.3	321.7	332.2	334.3	1.540	1.637
7.000	63.232	15.815	1336.1	-90.37	.498	315.3	17.6	.432	316.9	323.2	335.5	338.0	1.552	1.655
8.000	76.067	13.013	1273.0	-93.51	.493	319.6	15.3	.436	320.1	328.1	338.1	340.9	1.609	1.669
9.000	87.222	10.957	1219.4	-96.14	.489	323.2	13.2	.440	327.3	340.2	343.2	345.1	1.691	1.701
10.000	106.409	9.599	1173.1	-98.39	.485	326.2	11.2	.445	331.0	341.9	345.4	347.2	1.700	1.708
11.000	122.445	8.154	1132.5	-100.36	.482	328.8	10.4	.447	334.3	343.3	347.2	348.8	1.700	1.708
12.000	139.596	7.166	1096.6	-102.08	.479	331.1	9.7	.447	337.1	344.6	348.8	350.2	1.708	1.716
13.000	157.113	6.466	1064.5	-103.62	.477	333.1	9.1	.448	340.1	345.5	350.2	351.4	1.716	1.720
14.000	175.082	5.712	1035.0	-105.00	.475	334.9	8.6	.449	342.6	346.9	351.4	352.5	1.720	1.726
15.000	193.309	5.173	1009.0	-106.25	.473	336.5	8.0	.449	344.7	347.2	352.5	353.5	1.726	1.731
16.000	211.762	4.723	984.9	-107.39	.471	338.0	7.5	.449	346.1	348.5	353.5	354.5	1.731	1.735
17.000	230.272	4.363	962.7	-108.44	.469	339.3	7.0	.449	347.1	349.8	354.5	355.5	1.735	1.740
18.000	248.835	4.019	942.1	-109.40	.468	340.5	6.6	.449	347.1	349.8	354.5	355.5	1.740	1.746
19.000	269.768	3.707	923.0	-110.29	.466	341.7	6.2	.449	347.1	349.8	354.5	355.5	1.746	1.751
20.000	291.535	3.430	905.2	-111.13	.465	342.7	5.8	.449	347.1	349.8	354.5	355.5	1.751	1.756
21.000	313.829	3.186	888.5	-111.90	.464	343.7	5.4	.449	347.1	349.8	354.5	355.5	1.756	1.761
22.000	336.562	2.971	872.9	-112.62	.463	344.6	5.0	.449	347.1	349.8	354.5	355.5	1.761	1.766
23.000	359.644	2.780	858.2	-113.30	.462	345.5	4.6	.449	347.1	349.8	354.5	355.5	1.766	1.771
24.000	383.080	2.611	844.3	-113.94	.461	346.3	4.2	.449	347.1	349.8	354.5	355.5	1.771	1.776
25.000	406.707	2.459	831.2	-114.55	.460	347.1	3.8	.449	347.1	349.8	354.5	355.5	1.776	1.781
26.000	430.518	2.323	818.6	-115.12	.459	347.8	3.4	.449	347.1	349.8	354.5	355.5	1.781	1.786
27.000	454.502	2.200	806.7	-115.65	.458	348.5	3.0	.449	347.1	349.8	354.5	355.5	1.786	1.791
28.000	478.427	2.090	795.7	-116.16	.457	349.1	2.6	.449	347.1	349.8	354.5	355.5	1.791	1.796
29.000	502.423	1.990	785.0	-116.64	.456	349.7	2.2	.449	347.1	349.8	354.5	355.5	1.796	1.801
30.000	526.392	1.900	774.6	-117.11	.455	350.3	1.8	.449	347.1	349.8	354.5	355.5	1.801	1.806
31.000	550.298	1.817	764.6	-117.57	.455	350.8	1.4	.449	347.1	349.8	354.5	355.5	1.806	1.811
32.000	574.120	1.742	755.0	-118.00	.454	351.4	1.0	.449	347.1	349.8	354.5	355.5	1.811	1.816
33.000	597.856	1.673	746.7	-118.41	.454	351.9	0.6	.449	347.1	349.8	354.5	355.5	1.816	1.821
34.000	621.434	1.609	738.1	-118.80	.453	352.3	0.2	.449	347.1	349.8	354.5	355.5	1.821	1.826
35.000	644.862	1.548	729.8	-119.17	.453	352.8	0.0	.449	347.1	349.8	354.5	355.5	1.826	1.831
36.000	668.152	1.480	721.8	-119.53	.452	353.3	0.0	.449	347.1	349.8	354.5	355.5	1.831	1.836
37.000	691.397	1.420	714.2	-119.88	.452	353.7	0.0	.449	347.1	349.8	354.5	355.5	1.836	1.841
38.000	714.534	1.365	706.8	-120.21	.451	354.1	0.0	.449	347.1	349.8	354.5	355.5	1.841	1.846
39.000	737.571	1.312	699.6	-120.54	.451	354.5	0.0	.449	347.1	349.8	354.5	355.5	1.846	1.851
40.000	761.520	1.263	692.0	-120.85	.450	354.9	0.0	.449	347.1	349.8	354.5	355.5	1.851	1.856
41.000	785.378	1.218	684.1	-121.15	.450	355.2	0.0	.449	347.1	349.8	354.5	355.5	1.856	1.861
42.000	809.142	1.175	675.6	-121.44	.450	355.6	0.0	.449	347.1	349.8	354.5	355.5	1.861	1.866
43.000	832.812	1.134	667.4	-121.72	.449	355.9	0.0	.449	347.1	349.8	354.5	355.5	1.866	1.871
44.000	856.387	1.094	658.7	-122.00	.449	356.3	0.0	.449	347.1	349.8	354.5	355.5	1.871	1.876
45.000	880.861	1.055	649.5	-122.27	.448	356.6	0.0	.449	347.1	349.8	354.5	355.5	1.876	1.881
46.000	905.235	1.027	640.0	-122.54	.448	356.9	0.0	.449	347.1	349.8	354.5	355.5	1.881	1.886
47.000	929.509	.995	630.3	-122.81	.448	357.2	0.0	.449	347.1	349.8	354.5	355.5	1.886	1.891
48.000	953.683	.965	620.6	-123.08	.447	357.5	0.0	.449	347.1	349.8	354.5	355.5	1.891	1.896
49.000	977.757	.937	610.7	-123.35	.447	357.8	0.0	.449	347.1	349.8	354.5	355.5	1.896	1.901
50.000	1009.124	.910	600.7	-123.62	.447	358.0	0.0	.449	347.1	349.8	354.5	355.5	1.901	1.906
7.384	66.046	14.696	1311.7	-91.59	.496	317.0	22.1	1.505	317.0	323.6	336.5	339.1	1.552	1.640

SHIPPING EXPANSION													
C STAR = 6695.8 FT/SEC													
EPSILON	PC/P	P PSIA	TEMP DEG K	ENTHALPY CAL/GM	CP CAL/GM	I OPT	DELVAC I SEA	I AT	I AT	I VAC	CF SEA	CF VAC	
				1000G	GH DEG		LVL	10000	50000		LVL	LVL	
1.000	1.000	1000.000	3421.8	23.91	.956	.842	162.2	116.5	.208	255.6	256.5	256.5	1.228
2.000	10.011	90.886	2096.4	-50.77	.541	255.6	43.0	.430	292.2	294.1	297.8	298.5	1.431
3.000	17.930	56.085	1812.4	-65.93	.528	279.6	34.6	.417	305.1	307.9	313.2	314.2	1.496
4.000	22.207	35.452	1635.6	-75.28	.518	293.8	29.6	.436	311.2	316.9	322.0	323.5	1.523
5.000	36.551	25.939	1508.6	-81.70	.510	303.1	24.6	.425	316.6	316.2	328.8	329.7	1.540
6.000	50.492	19.605	1412.4	-86.54	.503	310.0	20.4	.420	316.3	321.7	332.2	334.3	1.540
7.000	63.232	15.815	1336.1	-90.37	.498	315.3	17.6	.432	316.9	323.2	335.5	338.0	1.567
8.000	76.067	13.013	1273.0	-93.51	.493	319.6	15.3	.436	320.1	328.1	338.1	340.9	1.603
9.000	87.222	10.957	1219.4	-96.14	.489	323.2	13.2	.440	327.3	340.2	343.2	345.1	1.691
10.000	106.409	9.599	1173.1	-98.39	.485	326.2	11.2	.445	331.0	341.9	345.4	347.2	1.700
11.000	122.445	8.154	1132.5	-100.36	.482	328.8	10.4	.447	334.3	343.3	347.2	348.8	1.716
12.000	139.596	7.166	1096.6	-102.08	.479	331.1	9.7	.447	337.1	344.6	348.8	350.2	1.726
13.000	157.113	6.448	1064.5	-103.62	.477	333.1	9.1	.448	340.1	345.5	350.2	351.4	1.731
14.000	175.082	5.712	1035.0	-105.00	.475	334.9	8.6	.449	342.6	346.9	351.4	352.5	1.735
15.000	193.309	5.173	1009.0	-106.25	.473	336.5	8.0	.449	344.7	347.2	352.5	353.5	1.740
16.000	211.762	4.723	984.9	-107.39	.471	338.0	7.5	.449	346.1	348.5	353.5	354.5	1.746
17.000	230.272	4.363	962.7	-108.44	.469	339.3	7.0	.449	347.1	349.8	354.5	355.5	1.751
18.000	248.835	4.019	942.1	-109.40	.468	340.5	6.6	.449	347.1	349.8	354.5	355.5	1.756
19.000	269.768	3.707	923.0	-110.29	.466	341.7	6.2	.449	347.1	349.8	354.5	355.5	1.761
20.000	291.535	3.430	905.2	-111.13	.465	342.7	5.8	.449	347.1	349.8	354.5	355.5	1.766
21.000	313.829	3.186	888.5	-111.90	.464	343.7	5.4	.449	347.1	349.8	354.5	355.5	1.771
22.000	336.562	2.971	872.9	-112.62	.463	344.6	5.0	.449	347.1	349.8	354.5	355.5	1.776
23.000	359.644	2.780	858.2	-113.30	.462	345.5	4.6	.449	347.1	349.8	354.5	355.5	1.781
24.000	382.726	2.600	843.5	-113.92	.461	346.4	4.2	.449	347.1	349.8	354.5	355.5	1.786
25.000	405.808	2.439	828.8	-114.50	.460	347.3	3.8	.449	347.1	349.8	354.5	355.5	1.791
26.000	428.890	2.296	814.1	-115.04	.459	348.2	3.4	.449	347.1	349.8	354.5	355.5	1.796
27.000	451.972	2.169	799.4	-115.55	.458	349.1	3.0	.449	347.1	349.8	354.5	355.5	1.801
28.000	475.054	2.057	784.7	-116.03	.457	350.0	2.6	.449	347.1	349.8	354.5	355.5	1.806
29.000	498.136	1.958	770.0	-116.48	.456	350.9	2.2	.449	347.1	349.8	354.5	355.5	1.811
30.000	521.218	1.872	755.3	-116.90	.455	351.8	1.8	.449	347.1	349.8	354.5	355.5	1.816
31.000	544.300	1.797	740.6	-117.29	.454	352.7	1.4	.449	347.1	349.8	354.5	355.5	1.821
32.000	567.382	1.733	725.9	-117.65	.453	353.6	1.0	.449	347.1	349.8	354.5	355.5	1.826
33.000	590.464	1.678	711.2	-117.98	.452	354.5	.6	.449	347.1	349.8	354.5	355.5	1.831
34.000	613.546	1.632	696.5	-118.29	.451	355.4	.2	.449	347.1	349.8	354.5	355.5	1.836
35.000	636.628	1.594	681.8	-118.57	.450	356.3	.0	.449	347.1	349.8	354.5	355.5	1.841
36.000	659.710	1.563	667.1	-118.82	.449	357.2	.0	.449	347.1	349.8	354.5	355.5	1.846
37.000	682.792	1.538	652.4	-119.05	.448	358.1	.0	.449	347.1	349.8	354.5	355.5	1.851
38.000	705.874	1.518	637.7	-119.26	.447	359.0	.0	.449	347.1	349.8	354.5	355.5	1.856
39.000	728.956	1.501	623.0	-119.45	.446	359.9	.0	.449	347.1	349.8	354.5	355.5	1.861
40.000	752.038	1.486	608.3	-119.62	.445	360.8	.0	.449	347.1	349.8	354.5	355.5	1.866
41.000	775.120	1.472	593.6	-119.77	.444	361.7	.0	.449	347.1	349.8	354.5	355.5	1.871
42.000	798.202	1.459	578.9	-119.90	.443	362.6	.0	.449	347.1	349.8	354.5	355.5	1.876
43.000	821.284	1.447	564.2	-120.02	.442	363.5	.0	.449	347.1	349.8	354.5	355.5	1.881
44.000	844.366	1.436	549.5	-120.13	.441	364.4	.0	.449	347.1	349.8	354.5	355.5	1.886
45.000	867.448	1.426	534.8	-120.23	.440	365.3	.0	.449	347.1	349.8	354.5	355.5	1.891
46.000	890.530	1.417	520.1	-120.32	.439	366.2	.0	.449	347.1	349.8	354.5	355.5	1.896
47.000	913.612	1.409	505.4	-120.40	.438	367.1	.0	.449	347.1	349.8	354.5	355.5	1.901
48.000	936.694	1.402	490.7	-120.47	.437	368.0	.0	.449	347.1	349.8	354.5	355.5	1.906
49.000	959.776	1.396	476.0	-120.53	.436	368.9	.0	.449	347.1	349.8	354.5	355.5	1.911
50.000	982.858	1.391	461.3	-120.58	.435	369.8	.0	.449	347.1	349.8	354.5	355.5	1.916
7.728	68.048	16.096	1669.5	-98.06	.505	325.7	23.6	1.607	325.7	332.8	340.6	349.4	1.565

PRESSURE PROFILE DATA
 SYSTEM LIQUID BI-PROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 128 O*F2 1.53 +3.5 50.
 298 N2*H4 1.004 +12.05 50.

BULK DENSITY = 1.212 GM/CC
 MIXTURE RATIO = 1.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 321.08 EU/100GMS

CHAMBER	FROZEN EXPANSION										THROAT		
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	548.8
TEMP, DEG K	3710.0	3047.5	2491.1	2024.0	1632.1	1434.0	1304.1	1031.7	808.4	628.7	488.3	375.3	3265.5
ENTHALPY (-)	-22.04	13.95	43.46	67.51	86.98	96.50	102.61	115.04	124.83	132.48	138.40	142.97	2.20
CP	.5492	.5367	.5230	.5058	.4866	.4745	.4659	.4467	.4309	.4199	.4135	.4098	.5414
IMPUL OPT	176.96	238.71	279.11	307.96	321.13	329.30	345.33	357.45	366.63	373.60	378.88	383.88	145.23
IMPUL VAC	263.87	291.37	315.71	334.71	343.67	349.29	360.41	368.87	375.29	380.17	383.88	383.88	258.71
EPSILON	1.056	1.607	2.805	5.150	7.417	9.666	18.316	34.830	66.331	126.479	241.759	1.000	

	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	565.3
TEMP, DEG K	3710.0	3276.9	2848.4	2413.9	1994.9	1771.4	1622.5	1305.4	1039.7	820.1	641.8	499.7	3440.0
ENTHALPY (-)	-22.04	14.91	46.82	73.96	96.58	107.81	115.09	130.07	142.06	151.96	159.03	164.86	1.46
X BAR	5.838	5.730	5.656	5.619	5.608	5.607	5.607	5.606	5.606	5.606	5.606	5.606	5.767
N	5.838	5.730	5.656	5.619	5.608	5.607	5.607	5.606	5.606	5.606	5.606	5.606	5.767
CP	1.1913	.9670	.7443	.5890	.5150	.4943	.4834	.4611	.4415	.4250	.4134	.4081	1.0562
IMPUL OPT	179.30	244.75	288.99	321.23	336.10	345.39	363.76	377.83	388.62	396.89	403.23	403.23	143.00
IMPUL VAC	269.83	301.66	329.57	351.34	361.65	368.16	381.16	391.17	398.85	404.73	409.23	409.23	262.94
EPSILON	1.072	1.692	3.031	5.649	8.193	10.731	20.591	39.660	76.403	147.063	283.047	1.000	

	COMPOSITION SHIFTING (MOL/100 GM)												
18.86 F	.0087	.0029	.0006	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0046
-64.50 F*H	1.8431	1.8490	1.8512	1.8518	1.8519	1.8519	1.8519	1.8519	1.8519	1.8519	1.8519	1.8519	1.8473
-26.10 F*H*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
58.60 F*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-15.70 F*N*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.2975	.1743	.0777	.0217	.0032	.0007	.0002	.0000	.0000	.0000	.0000	.0000	.2188
79.20 H*N	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-10.00 H*N*O	.0030	.0014	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0019
9.33 H*O	.1030	.0517	.0173	.0031	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0697
.00 H2	1.2160	1.2229	1.2415	1.2595	1.2670	1.2681	1.2684	1.2685	1.2684	1.2684	1.2683	1.2674	1.2186
40.30 H2*N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2*O	.7807	.8591	.9054	.9225	.9257	.9259	.9259	.9259	.9259	.9259	.9259	.9259	.8327
-11.04 H3*N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	.0007	.0000
113.00 N	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
21.65 N*O	.0179	.0071	.0017	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0105
8.06 N*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	1.5494	1.5558	1.5590	1.5600	1.5601	1.5602	1.5602	1.5602	1.5602	1.5601	1.5601	1.5598	1.5538
19.50 N2*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.0141	.0043	.0007	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0072
.00 O2	.0036	.0012	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0019

SYSTEM LIQUID NITROPROPellant										PC 1000, PSIA									
COMPONENT										DENSITY									
REF FORMULA										HEAT FORM									
DEG K										1.50									
128 0°F2										1.000									
298 N2+H4										12.05									
PROZEN EXPANSION										C STAR = 6832.5 FT/SEC									
EPSILON										I SEA									
PC/P										I AT 10000									
P PSIA										I AT 50000									
TEMP										I VAC									
ENTHALPY										CF SEA									
CP CAL/ I OPT										CF VAC									
DEG K										LVL									
1.000	1.822	1.000	300.00	3205.5	-2.20	.541	145.2	113.5	.207	255.7	256.6	258.4	258.7	1.236	1.252				
2.000	1.939	100.21	2280.8	-54.41	.516	258.6	43.7	.436	295.8	297.8	301.5	302.2	1.431	1.464					
3.000	1.736	56.376	175.5	-64.93	.504	282.9	35.2	.624	309.0	311.7	317.1	318.1	1.584	1.539					
4.000	28.037	35.667	1783.4	-79.55	.495	297.4	30.2	.487	315.1	318.9	325.1	327.6	1.526	1.584					
5.000	68.219	26.110	1849.0	-66.15	.488	303.5	25.3	.503	318.7	323.1	332.1	333.9	1.541	1.615					
6.000	50.067	19.973	1546.1	-91.14	.482	313.8	24.9	1.245	320.4	325.9	336.5	338.7	1.549	1.638					
7.000	62.655	15.960	1463.8	-75.08	.476	319.2	23.1	1.450	321.0	327.5	339.3	342.3	1.553	1.656					
8.000	76.063	13.147	1349.8	-98.31	.472	323.6	21.8	1.656	326.3	342.5	345.3			1.670					
9.000	102.121	11.071	1038.0	-121.03	.468	328.0	20.6	1.862	328.7	346.7				1.682					
10.000	165.194	9.100	1288.2	-10.35	.465	330.5	19.7	2.070		346.4	350.0			1.693					
11.000	121.119	8.256	1244.5	-105.38	.462	332.9	18.9	2.284		347.9	351.8			1.701					
12.000	137.748	7.258	1205.7	-107.16	.459	335.3	18.1	2.500		349.1	353.4			1.709					
13.000	155.024	6.451	1170.9	-108.76	.457	337.3	17.5	2.715		350.2	354.8			1.716					
14.000	172.690	5.791	109.5	-110.19	.455	339.5	17.0	2.930		351.1	355.8			1.722					
15.000	190.860	5.245	111.07	-111.48	.452	340.8	16.4	3.146		351.9	357.3			1.728					
16.000	208.825	4.749	108.67	-112.66	.451	342.3	16.0	3.339		352.6	358.3			1.733					
17.000	227.054	4.403	106.64	-113.75	.449	343.7	15.6	3.536		353.2	359.3			1.738					
18.000	245.463	4.075	1038.4	-114.76	.447	345.0	15.2	3.728		353.8	360.1			1.742					
19.000	265.867	3.767	1017.8	-115.67	.446	346.1	14.8	3.939		354.2	361.0			1.746					
20.000	286.534	3.486	998.2	-116.53	.444	347.2	14.5	4.162		354.6	361.7			1.749					
21.000	308.725	3.239	980.1	-117.33	.443	348.2	14.2	4.389		354.9	362.4			1.753					
22.000	331.075	3.021	963.1	-118.09	.442	349.2	13.9	4.607		355.2	363.1			1.756					
23.000	353.741	2.821	947.1	-118.79	.441	350.2	13.7	4.819		355.5	363.8			1.759					
24.000	376.711	2.655	932.0	-119.46	.440	350.9	13.5	5.049		355.8	364.3			1.762					
25.000	399.349	2.500	917.7	-120.09	.439	351.6	13.2	5.266		356.1	364.8			1.764					
26.000	423.311	2.362	904.1	-120.68	.438	352.4	12.9	5.481		356.0	365.3			1.767					
27.000	446.992	2.242	891.2	-121.24	.437	353.2	12.7	5.694		356.1	365.8			1.769					
28.000	470.534	2.125	879.0	-121.78	.436	353.7	12.5	5.899		356.2	366.3			1.771					
29.000	494.156	2.023	867.3	-122.29	.435	354.3	12.3	6.103		356.3	366.7			1.773					
30.000	517.835	1.931	856.1	-122.77	.434	354.9	12.2	6.307		356.3	367.1			1.775					
31.000	541.428	1.847	845.4	-123.23	.433	355.5	12.0	6.497		356.4	367.5			1.777					
32.000	564.947	1.770	835.2	-123.68	.433	356.1	11.9	6.677		356.5	367.9			1.779					
33.000	588.372	1.700	825.4	-124.10	.432	356.6	11.7	6.873		356.7	368.2			1.781					
34.000	611.662	1.635	816.0	-124.51	.431	357.1	11.5	7.054		356.8	368.6			1.783					
35.000	635.554	1.573	806.9	-124.90	.431	357.5	11.4	7.239		356.9	368.9			1.784					
36.000	659.070	1.508	798.2	-125.27	.430	358.0	11.3	7.416		357.0	369.2			1.786					
37.000	680.340	1.447	789.8	-125.64	.430	358.4	11.1	7.601		357.1	369.5			1.787					
38.000	719.161	1.390	781.7	-125.98	.429	358.9	11.0	7.796		357.2	369.8			1.789					
39.000	747.771	1.337	773.9	-126.32	.429	359.3	10.9	8.128		357.0	370.1			1.790					
40.000	776.686	1.288	766.3	-126.64	.428	359.7	10.8	8.351		357.1	370.4			1.791					
41.000	805.930	1.242	759.0	-126.96	.428	360.0	10.7	8.568		357.2	370.7			1.792					
42.000	835.462	1.197	751.9	-127.26	.427	360.4	10.5	8.795		357.3	370.9			1.794					
43.000	865.156	1.156	745.1	-127.55	.427	360.7	10.4	9.017		357.4	371.2			1.795					
44.000	895.141	1.117	738.5	-127.83	.426	361.1	10.3	9.237		357.4	371.4			1.796					
45.000	925.400	1.080	732.0	-128.11	.426	361.4	10.2	9.457		357.5	371.7			1.797					
46.000	955.725	1.046	725.5	-128.37	.426	361.7	10.1	9.676		357.6	371.9			1.798					
47.000	986.215	1.014	719.7	-128.63	.425	362.0	10.0	9.893		357.7	372.1			1.800					
48.000	1016.970	.983	713.8	-128.88	.425	362.3	9.9	10.109		357.8	372.3			1.801					
49.000	1047.766	.954	708.1	-129.12	.424	362.6	9.8	10.323		357.9	372.5			1.802					
50.000	1078.704	.927	702.4	-129.36	.424	362.9	9.7	10.536		358.0	372.7			1.803					
7.417	68.246	14.696	134.00	-96.50	.475	321.1	22.5	1.534	321.1	327.9	341.7	1.553	1.665						

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000, PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 128 O*F2 1.53 +3.5 56.
 298 N2*H4 1.004 +12.05 44.

BULK DENSITY = 1.243 GM/CC
 MIXTURE RATIO = 1.273 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 310.08 EU/100GMS

CHAMBER	FROZEN EXPANSION										THRUST		
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	548.5
TEMP, DEG K	3930.8	3224.2	2632.5	2137.4	1722.9	1513.9	1376.8	1089.4	853.6	663.5	512.8	395.1	3456.1
ENTHALPY (-)	-20.17	15.92	45.47	89.53	89.01	98.53	104.64	117.07	126.86	134.51	140.43	145.00	4.17
CP	.5159	.5054	.4928	.4783	.4607	.4500	.4418	.4233	.4076	.3966	.3898	.3863	.5091
IMPUL OPT	177.21	238.97	279.36	308.19	321.35	329.51	345.54	357.65	366.83	373.78	379.06	384.04	259.05
IMPUL VAC	264.18	291.63	315.93	334.91	343.87	349.49	360.61	369.06	375.47	380.34	384.04	384.04	259.05
EPSILON	1.055	1.605	2.800	5.140	7.403	9.649	18.288	34.776	66.198	126.123	240.688	1.000	

	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	569.0
TEMP, DEG K	3930.8	3530.8	3157.6	2781.6	2381.2	2143.7	1977.8	1813.6	1301.9	1039.7	822.2	644.9	3681.4
ENTHALPY (-)	-20.17	17.10	49.78	78.32	102.85	115.29	123.42	140.33	154.05	165.06	173.81	180.70	3.22
X BAR	5.529	5.398	5.289	5.210	5.170	5.160	5.158	5.156	5.156	5.156	5.156	5.156	5.447
N	5.529	5.398	5.289	5.210	5.170	5.160	5.158	5.156	5.156	5.156	5.156	5.156	5.447
CP	1.4389	1.2836	1.0426	.7668	.5681	.5081	.4828	.4505	.4295	.4107	.3946	.3834	1.3546
IMPUL OPT	180.07	246.70	292.71	327.14	343.29	353.44	373.67	389.31	401.42	410.80	418.03	424.91	142.66
IMPUL VAC	271.57	305.22	335.52	359.67	371.15	378.39	392.92	404.21	412.97	419.72	424.91	424.91	142.66
EPSILON	1.076	1.729	3.177	6.065	8.878	11.685	22.642	44.044	85.688	166.325	322.014	1.000	

	COMPOSITION SHIFTING (MOL/100 GM)												
18.86 F	.0235	.0108	.0040	.0010	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0148
-64.50 F*H	2.0505	2.0633	2.0701	2.0731	2.0740	2.0741	2.0741	2.0741	2.0741	2.0741	2.0741	2.0741	2.0592
-26.10 F*H*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
58.60 F*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-15.70 F*N*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.3449	.2359	.1431	.0684	.0205	.0075	.0031	.0002	.0000	.0000	.0000	.0000	.2763
79.20 H*N	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
-10.00 H*N*O	.0048	.0028	.0014	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0035
9.33 H*O	.1955	.1354	.0766	.0297	.0059	.0015	.0005	.0000	.0000	.0000	.0000	.0000	.1590
.00 H2	.7433	.7042	.6736	.6611	.6654	.6690	.6705	.6717	.6718	.6718	.6718	.6718	.7189
40.30 H2*N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2*O	.7044	.6228	.5267	.3990	1.0302	1.0353	1.0365	1.0370	1.0370	1.0370	1.0370	1.0370	.7778
-11.04 H3*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
21.65 N*O	.0448	.0264	.0123	.0036	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0331
8.06 N*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	1.3476	1.3582	1.3661	1.3709	1.3726	1.3729	1.3729	1.3729	1.3729	1.3729	1.3729	1.3729	1.3544
19.50 N2*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.0502	.0258	.0095	.0019	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0343
.00 O2	.0186	.0119	.0053	.0012	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0146
34.10 O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. G/G
 DEG K GM/CC (KCAL/FORM.WT.)
 128 O₂F₂ 1.53 +3.5 62.
 298 N₂H₄ 1.004 +12.05 38.

BULK DENSITY = 1.276 GM/CC
 MIXTURE RATIO = 1.632 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 298.05 EU/100GMS

CHAMBER													THROAT
FROZEN EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	547.4
TEMP, DEG K	4082.5	3336.7	2715.1	2197.1	1765.7	1548.8	1406.9	1110.2	867.6	672.6	518.6	398.7	3579.4
ENTHALPY (-)	-18.31	17.26	46.27	69.81	88.80	98.07	104.00	116.06	125.53	132.90	138.60	142.99	5.77
CP	.4815	.4717	.4608	.4477	.4319	.4222	.4146	.3977	.3832	.3733	.3671	.3641	.4753
IMPUL OPT	175.90	237.01	276.87	305.25	318.18	326.19	341.89	353.74	362.69	369.46	374.59	379.42	144.72
IMPUL VAC	262.06	289.05	312.92	331.53	340.29	345.79	356.64	364.88	371.11	375.84	379.42	380.06	257.06
EPSILON	1.055	1.600	2.784	5.097	7.331	9.547	18.053	34.253	65.058	123.688	235.566	1.000	
SHIFTING EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	570.2
TEMP, DEG K	4082.5	3686.1	3335.2	3014.0	2705.7	2524.3	2389.7	2039.5	1678.6	1361.9	1093.6	869.3	3834.4
ENTHALPY (-)	-18.31	18.53	50.97	79.65	105.00	118.31	127.24	146.41	162.40	175.46	186.00	194.42	4.72
X BAR	5.254	5.116	4.993	4.887	4.800	4.760	4.738	4.709	4.706	4.705	4.705	4.705	5.169
N	5.254	5.116	4.993	4.887	4.800	4.760	4.738	4.709	4.706	4.705	4.705	4.705	5.169
CP	1.5151	1.4527	1.3349	1.1585	.9355	.7938	.6907	.4836	.4231	.4022	.3836	.3674	1.4835
IMPUL OPT	179.00	245.49	291.92	327.52	344.75	355.83	378.54	396.49	410.56	421.58	430.19	441.53	
IMPUL VAC	270.09	304.14	335.54	361.79	374.88	383.34	400.48	413.71	424.06	432.14	438.41	442.59	
EPSILON	1.078	1.743	3.256	6.428	9.658	12.957	25.954	51.184	100.731	197.869	387.162	1.000	
COMPOSITION SHIFTING (MOL/100 GM)													
18.86 F	.0515	.0275	.0136	.0060	.0022	.0010	.0005	.0000	.0000	.0000	.0000	.0000	.0353
-64.50 F=H	2.2448	2.2688	2.2827	2.2903	2.2941	2.2953	2.2958	2.2963	2.2963	2.2963	2.2963	2.2963	2.2609
-26.10 F=H=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
58.60 F=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-15.70 F=N=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.3235	.2263	.1461	.0834	.0390	.0217	.0130	.0025	.0002	.0000	.0000	.0000	.2623
79.20 H=N	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
-10.00 H=N=O	.0058	.0039	.0025	.0015	.0008	.0005	.0003	.0001	.0000	.0000	.0000	.0000	.0046
9.33 H=O	.2743	.2249	.1705	.1155	.0650	.0401	.0253	.0040	.0002	.0000	.0000	.0000	.2450
.00 H2	.4066	.3524	.2920	.2273	.1623	.1275	.1060	.0777	.0751	.0751	.0751	.0751	.3743
40.30 H2=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2=O	.5404	.6570	.7785	.8988	1.0097	1.0652	1.0983	1.1423	1.1480	1.1481	1.1481	1.1481	.6105
-11.04 H3=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0007	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004
21.65 N=O	.0833	.0618	.0428	.0267	.0139	.0081	.0049	.0006	.0000	.0000	.0000	.0000	.0700
8.06 N=O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	1.1406	1.1526	1.1630	1.1716	1.1784	1.1814	1.1831	1.1854	1.1857	1.1857	1.1857	1.1857	1.1481
19.50 N2=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.1198	.0812	.0492	.0252	.0097	.0043	.0020	.0001	.0000	.0000	.0000	.0000	.0955
.00 O2	.0622	.0596	.0523	.0403	.0246	.0150	.0087	.0006	.0000	.0000	.0000	.0000	.0612

SYSTEM LIQUID BIPHOPPELLANT
COMPONENT 1 REF FORMULA
DEC K
178 2062
298 42844

PC 1000, PSIA
DENSITY
CM/CC
1.53
1.004
+12.05

HEAT FORM
KCAL/FORM.M.T.
31.5
36.

WT. O/D
67.
36.

EPSILON	PC/F	P PSIA	TEMP DEG K	ENTHALPY KCAL/100GM	C STAR = 6602.5 FT/SEC		I SEA LVL	I AT 10000	I AT 50000	I VAC	CF SEA LVL	CF VAC
					CP CAL / I OPT	DEL VAC CEL VAC /P						
1.000	1.000	1000.000	4082.5	18.31	401	112.3	256.0	255.0	256.7	257.1	1.238	1.233
2.000	1.027	947.439	3579.4	-5.77	475	144.7	293.6	294.5	299.2	300.0	1.431	1.462
3.000	1.050	94.012	2475.4	-57.27	455	257.1	342.9	343.1	349.5	350.2	1.493	1.538
4.000	17.978	55.624	2117.4	-72.48	446	281.1	34.5	345.5	349.2	349.5	1.493	1.538
5.000	28.432	35.171	1525.5	-81.85	418	295.3	29.5	340.0	342.5	342.8	1.523	1.583
6.000	38.817	25.762	1777.9	-98.28	432	304.5	26.5	312.9	320.5	329.3	1.539	1.615
7.000	50.678	19.655	1665.0	-93.13	428	311.4	24.3	317.3	323.0	331.0	1.547	1.636
8.000	63.647	15.702	1576.9	-96.76	426	316.7	22.6	318.1	324.5	334.3	1.550	1.653
9.000	77.355	12.421	1500.6	-100.10	420	320.9	21.2	318.4	325.3	334.4	1.557	1.667
10.000	91.886	10.488	1437.6	-102.73	416	324.5	20.1	318.9	325.6	334.5	1.560	1.679
11.000	107.128	9.335	1383.2	-104.99	413	327.5	19.2	319.2	325.6	334.7	1.561	1.689
12.000	123.454	8.100	1335.6	-106.95	411	330.1	18.4	319.4	325.6	334.8	1.562	1.698
13.000	140.440	7.118	1293.3	-108.68	408	332.4	17.7	319.4	325.6	334.8	1.562	1.706
14.000	158.054	6.325	1256.5	-110.22	406	334.4	17.0	319.4	325.6	334.8	1.562	1.713
15.000	176.123	5.678	1221.3	-111.61	404	336.2	16.5	319.4	325.6	334.7	1.562	1.719
16.000	194.447	5.143	1190.3	-112.86	402	337.8	16.0	319.4	325.6	334.7	1.562	1.724
17.000	212.955	4.696	1161.8	-114.00	401	339.3	15.6	319.4	325.6	334.7	1.562	1.729
18.000	231.559	4.319	1135.6	-115.05	399	340.6	15.1	319.4	325.6	334.7	1.562	1.734
19.000	250.157	3.997	1111.4	-116.01	398	341.8	14.8	319.4	325.6	334.7	1.562	1.738
20.000	268.745	3.689	1088.9	-116.41	396	343.0	14.4	319.4	325.6	334.7	1.562	1.742
21.000	287.316	3.400	1067.8	-117.74	395	344.0	14.1	319.4	325.6	334.7	1.562	1.745
22.000	305.879	3.167	1048.7	-118.52	394	345.0	13.8	319.4	325.6	334.7	1.562	1.748
23.000	324.432	2.993	1029.7	-119.24	393	345.9	13.5	319.4	325.6	334.7	1.562	1.752
24.000	342.977	2.764	1012.3	-119.93	392	346.8	13.3	319.4	325.6	334.7	1.562	1.756
25.000	361.512	2.595	995.9	-120.57	391	347.6	13.0	319.4	325.6	334.7	1.562	1.757
26.000	380.032	2.444	980.4	-121.17	390	348.3	12.8	319.4	325.6	334.7	1.562	1.760
27.000	398.544	2.309	965.7	-121.75	389	349.1	12.6	319.4	325.6	334.7	1.562	1.762
28.000	417.057	2.187	951.7	-122.29	388	349.7	12.4	319.4	325.6	334.7	1.562	1.764
29.000	435.570	2.074	938.4	-122.81	387	350.4	12.2	319.4	325.6	334.7	1.562	1.767
30.000	454.083	1.973	925.7	-123.30	387	351.0	12.0	319.4	325.6	334.7	1.562	1.769
31.000	472.596	1.889	913.6	-123.76	386	351.6	11.8	319.4	325.6	334.7	1.562	1.771
32.000	491.109	1.807	902.0	-124.21	385	352.1	11.6	319.4	325.6	334.7	1.562	1.774
33.000	509.622	1.732	891.0	-124.64	385	352.6	11.5	319.4	325.6	334.7	1.562	1.776
34.000	528.135	1.663	880.3	-125.04	384	353.1	11.3	319.4	325.6	334.7	1.562	1.776
35.000	546.648	1.600	870.1	-125.44	383	353.6	11.2	319.4	325.6	334.7	1.562	1.779
36.000	565.161	1.544	860.3	-125.81	383	354.1	11.0	319.4	325.6	334.7	1.562	1.779
37.000	583.674	1.492	850.9	-126.17	382	354.6	10.9	319.4	325.6	334.7	1.562	1.781
38.000	602.187	1.441	841.8	-126.52	382	355.0	10.8	319.4	325.6	334.7	1.562	1.782
39.000	620.700	1.395	833.0	-126.86	381	355.4	10.6	319.4	325.6	334.7	1.562	1.784
40.000	639.213	1.353	824.5	-127.14	381	355.8	10.5	319.4	325.6	334.7	1.562	1.785
41.000	657.726	1.315	816.3	-127.43	380	356.1	10.4	319.4	325.6	334.7	1.562	1.786
42.000	676.239	1.280	808.4	-127.74	380	356.5	10.3	319.4	325.6	334.7	1.562	1.787
43.000	694.752	1.246	800.8	-128.08	380	356.9	10.2	319.4	325.6	334.7	1.562	1.789
44.000	713.265	1.216	793.3	-128.37	379	357.2	10.1	319.4	325.6	334.7	1.562	1.790
45.000	731.778	1.188	786.2	-128.64	379	357.5	10.0	319.4	325.6	334.7	1.562	1.791
46.000	750.291	1.163	779.2	-128.92	378	357.8	9.9	319.4	325.6	334.7	1.562	1.792
47.000	768.804	1.141	772.4	-129.16	378	358.2	9.8	319.4	325.6	334.7	1.562	1.793
48.000	787.317	1.120	765.9	-129.41	378	358.5	9.7	319.4	325.6	334.7	1.562	1.794
49.000	805.830	1.100	759.5	-129.65	377	358.8	9.6	319.4	325.6	334.7	1.562	1.795
50.000	824.343	1.081	753.3	-129.86	377	359.1	9.5	319.4	325.6	334.7	1.562	1.796
51.000	842.856	1.063	747.3	-130.11	377	359.3	9.4	319.4	325.6	334.7	1.562	1.797
52.000	861.369	1.046	741.8	-130.37	377	359.6	9.3	319.4	325.6	334.7	1.562	1.798

SHIFTING EXPANSION

EPSILON	PC/F	P PSIA	TEMP DEG K	ENTHALPY KCAL/100GM	CP CAL / I OPT	STAR = 6830.7 FT/SEC	DEL VAC CEL VAC /P	I SEA LVL	I AT 10000	I AT 50000	I VAC	CF SEA LVL	CF VAC LVL
1.000	1.000	1000.000	4082.5	18.31	1.535	121.1	217	259.5	260.4	262.2	262.5	1.237	1.222
2.000	1.027	970.180	3938.4	-4.72	1.481	141.5	234	293.6	294.5	299.2	300.0	1.430	1.470
3.000	1.050	122.680	3579.4	-58.27	1.298	258.6	334	334.9	335.8	340.5	341.2	1.492	1.538
4.000	14.788	67.135	3070.7	-81.33	1.103	287.4	34.5	340.0	342.5	342.8	343.0	1.523	1.583
5.000	21.878	55.624	2918.0	-87.85	1.094	304.0	40.7	340.0	342.5	342.8	343.0	1.562	1.621
6.000	28.432	35.171	2817.1	-96.19	1.021	315.7	37.2	340.0	342.5	342.8	343.0	1.582	1.662
7.000	36.657	27.250	2716.1	-102.66	1.004	324.5	35.0	340.0	342.5	342.8	343.0	1.604	1.693
8.000	46.311	22.464	2637.9	-107.31	1.006	331.3	33.3	340.0	342.5	342.8	343.0	1.615	1.718
9.000	51.334	18.744	2580.6	-111.39	1.003	337.1	32.0	340.0	342.5	342.8	343.0	1.620	1.738
10.000	62.161	16.047	2556.0	-116.01	1.000	341.9	30.8	340.0	342.5	342.8	343.0	1.623	1.756
11.000	71.759	14.533	2528.6	-119.40	1.000	346.1	29.8	340.0	342.5	342.8	343.0	1.624	1.771
12.000	80.468	12.761	2498.1	-122.19	1.000	349.8	28.9	340.0	342.5	342.8	343.0	1.624	1.784
13.000	87.556	11.664	2475.6	-124.96	1.000	353.0	28.2	340.0	342.5	342.8	343.0	1.624	1.796
14.000	94.044	9.955	2348.1	-127.34	1.000	356.0	27.5	340.0	342.5	342.8	343.0	1.624	1.806
15.000	100.937	8.414	2352.6	-129.51	1.000	358.6	26.8	340.0	342.5	342.8	343.0	1.624	1.816
16.000	117.131	6.213	2197.1	-131.51	1.000	361.0	26.3	340.0	342.5	342.8	343.0	1.624	1.824
17.000	132.823	4.750	2228.3	-133.55	1.000	363.2	25.7	340.0	342.5	342.8	343.0	1.624	1.832
18.000	144.111	3.933	2257.1	-135.06	1.000	365.3	25.2	340.0	342.5	342.8	343.0	1.624	1.839
19.000	155.662	3.406	2228.4	-136.05	1.000	367.2	24.8	340.0	342.5	342.8	343.0	1.624	1.846
20.000	167.307	3.077	2201.0	-138.14	1.000	368.9	24.3	340.0	342.5	342.8	343.0	1.624	1.852
21.000	179.113	2.811	2179.1	-139.11	1.000	370.4	23.9	340.0	342.5	342.8	343.0	1.624	1.858
22.000	191.072	2.596	2149.8	-140.88	1.000	371.7	23.5	340.0	342.5	342.8	343.0	1.624	1.864
23.000	203.100	2.426	2125.8	-142.10	1.000	373.6	23.2	340.0	342.5	342.8	343.0	1.624	1.869
24.000	215.197	2.287	2102.7	-143.27	1.000	375.0	22.8	340.0	342.5	342.8	343.0	1.624	1.874
25.000	227.345	2.169	2079.8	-144.39	1.000	376.2	22.5	340.0	342.5	342.8	343.0	1.624	1.878
26.000	239.533	2.071	2059.2	-145.45	1.000	377.4	22.2	340.0	342.5	342.8	343.0	1.624	1.882
27.000	251.611	1.987	2038.6	-146.45	1.000	378.6	21.9	340.0	342.5	342.8	343.0	1.624	1.887
28.000	263.642	1.917	2018.6	-147.42	1.000	379.7	21.6	340.0	342.5	342.8	343.0	1.624	1.890
29.000	275.557	1.850	1998.9	-148.33	1.000	380.7	21.4	340.0	342.5	342.8	343.0	1.624	1.894
30.000	287.316	1.785	1980.2	-149.19	1.000	381.7	21.2	340.0	342.5	342.8	343.0	1.624	1.898
31.000	300.000	1.725	1962.0	-150.06	1.000	382.7	20.9	340.0	342.5	342.8	343.0	1.624	1.901
32.000	312.224	1.670	1944.4	-150.86	1.000	383.6	20.6	340.0	342.5	342.8	343.0	1.624	1.904
33.000	324.933	1.619	1927.1	-151.64	1.000	384.5	20.4	340.0	342.5	342.8	343.0	1.624	1.907
34.000	338.168	1.571	1910.0	-152.39	1.000	385.4	20.2	340.0	342.5	342.8	343.0	1.624	1.910
35.000	350.918	1.526	1894.7	-153.10	1.000	386.2	20.0	340.0	342.5	342.8	343.0	1.624	1.913
36.000	363.163	1.482	1879.2	-153.80	1.000	386.9	19.8	340.0	342.5	342.8	343.0	1.624	1.916
37.000	374.912	1.440	1864.1	-154.47	1.000	387.7	19.6	340.0	342.5	342.8	343.0	1.624	1.918
38.000	386.169	1.400	1849.2	-155.13	1.000	388.4	19.4	340.0	342.5	342.8	343.0	1.624	1.921
39.000	396.942	1.361	1834.5	-155.73	1.000	389.1	19.2	340.0	342.5	342.8	343.0	1.624	1.924
40.000	407.237	1.324	1820.1	-156.34	1.000	389.8	19.0	340.0	342.5	342.8	343.0	1.624	1.926
41.000	417.057	1.288	1807.8	-156.92	1.000	390.4	18.8	340.0	342.5	342.8	343.0	1.624	1.928
42.000	426.397	1.254	1796.7	-157.49	1.000	391.1	18.7	340.0	342.5	342.8	343.0	1.624	1.930
43.000	435.151	1.221	1785.9	-158.02	1.000	391.8	18.5	340.0	342.5	342.8	343.0	1.624	1.932
44.000	443.431	1.189	1765.5	-158.57	1.000	392.3	18.3	340.0	342.5	342.8	343.0	1.624	1.934
45.000	451.893	1.158	1757.4	-159.09	1.000	392.8	18.2	340.0	342.5	342.8	343.0	1.624	1.936
46.000	459.938	1.128	1749.6	-159.59	1.000	393.3	18.0	340.0	342.5	342.8	343.0	1.624	1.938
47.000	467.458	1.099	1742.0	-160.07	1.000	393.8	17.9	340.0	342.5	342.8	343.0	1.624	1.940
48.000	474.566	1.070	1722.8	-160.55	1.000	394.3	17.8	340.0	342.5	342.8	343.0	1.624	1.942
49.000	481.263	1.041	1711.8	-161.01	1.000	394.8	17.6	340.0	342.5	342.8	343.0	1.624	1.943
50.000	487.780	1.014	1701.1	-161.46	1.000	395.3	17.5	340.0	342.5	342.8	343.0	1.624	1.945
51.000	494.178	0.987	1690.7	-161.90	1.000	395.8	17.4	340.0	342.5	342.8	343.0	1.624	1.946
52.000	500.482	0.961	1680.7	-162.31	1.000	396.3	17.3	340.0	342.5	342.8	343.0	1.624	1.947
53.000	506.704	0.936	1671.0	-162.71	1.000	396.7	17.1	340.0	342.5	342.8	343.0	1.624	1.948
54.000	512.854	0.911	1661.6	-163.09	1.000	397.2	17.0	340.0	342.5	342.8	343.0	1.624	1.949
55.000	518.933	0.887	1652.4	-163.46	1.000	397.7	16.9	340.0	342.5	342.8	343.0	1.624	1.950
56.000	524.941	0.863	1643.4	-163.81	1.000	398.2	16.8	340.0	342.5	342.8	343.0	1.624	1.951
57.000	530.888	0.840	1634.6	-164.15	1.000	398.7	16.7	340.0	342.5	342.8	343.0	1.624	1.952
58.000	536.783	0.817	1626.0	-164.47	1.000	399.2	16.6	340.0	342.5	342.8	343.0	1.624	1.953
59.000	542.626	0.795	1617.6	-164.78	1.000	399.7	16.5	340.0	342.5	342.8	343.0	1.624	1.954
60.000	548.417	0.773	1609.3	-165.08	1.000	400.2	16.4	340.0	342.5	342.8	343.0	1.624	1.955
61.000	554.156	0.752	1601.1	-165.37	1.000	400.7	16.3	340.0	342.5	342.8	343.0	1.624	1.956
62.000	559.843	0.731	1593.0	-165.65	1.000	401.2	16.2	340.0	342.5	342.8	343.0	1.624	1.957
63.000	565.478	0.710	1585.0	-165.92	1.000	401.7	16.1	340.0	342.5	342.8	343.0	1.624	1.958
64.000	571.061	0.690	1577.1	-166.19	1.000	402.2	16.0	340.0	342.5	342.8	343.0	1.624	1.959
65.000	576.592	0.670	1569.3	-166.45	1.000	402.7	15.9	340.0	342.5	342.8	343.0	1.624	1.960
66.000	582.071	0.650	1561.6	-166.70	1.000	403.2	15.8	340.0	342.5	342.8	343.0	1.624	1.961
67.000	587.500	0.630	1554.0	-166.94	1.000	403.7	15.7	340.0	342.5	342.8	343.0	1.624	1.962
68.000	592.879	0.610	1546.5	-167.18	1.000	404.2	15.6	340.0	342.5	342.8	343.0	1.624	1.963
69.000	598.208	0.590	1539.1	-167.41	1.000	404.7	15.5	340.0	342.5	342.8	343.0	1.624	1.964
70.000	603.487	0.570	1531.8	-167.63	1.000	405.2	15.4	340.0	342.5	342.8	343.0	1.624	1.965
71.000	608.716	0.550	1524.6	-167.85	1.000	405.7	15.3	340.0	342.5	342.8	343.0	1.624	1.966
72.000	613.895	0.530	1517.5	-168.07	1.000	406.2	15.2	340.0	342.5	342.8	343.0	1.624	1.967
73.000	619.024	0.510	1510.5	-168.28	1.000	406.7	15.1	340.0	342.5	342.8	343.0	1.624	1.968
74.000	624.103	0.490	1503.6	-168.49	1.000	407.2	15.0	340.0	342.5	342.8	343.0	1.624	1.969
75.000	629.132	0.470	1496.7	-168.69	1.000	407.7	14.9	340.0	342.5	342.8	343.0	1.624	1.970
76.000	634.111	0.450	1489.9	-168.89	1.000	408.2	14.8	340.0	342.5	342.8	343.0	1.624	1.971
77.000	639.040	0.430	1483.2	-169.08	1.000	408.7	14.7	340.0	342.5	342.8	343.0	1.624	1.972
78.000	643.919	0.410	1476.6	-169.27	1.000	409.2	14.6	340.0	342.5	342.8	343.0	1.624	1.973
79.000	648.748	0.390	1470.1	-169.45	1.000	409.7	14.5	340.0	342.5	342.8	343.0	1.624	1.974
80.000	653.527	0.370	1463.7	-169.63	1.000	410.2	14.4	340.0	342.5	342.8	343.0	1.624	1.975
81.000	658.256	0.350	1457.3	-169.80	1.000	410.7	14.3	340.0	342.5	342.8	343.0	1.624	1.976
82.000	662.935	0.330	1451.0	-169.97	1.000	411.2	14.2	340.0	342.5	342.8	343.0	1.624	1.977
83.000	667.564	0.310	1444.8	-170.14	1.000	411.7	14.1	340.0	342.				

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. G/O
 DEG K GM/CC (KCAL/FORM.WT.)
 128 O₂F₂ 1.53 +3.5 70.
 298 N₂H₄ 1.004 +12.05 30.

BULK DENSITY = 1.322 GM/CC
 MIXTURE RATIO = 2.333 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 280.40 EU/100GMS

CHAMBER

THROAT

	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	544.8
PROSSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	544.8
TEMP, DEG K	4205.9	3412.0	2755.5	2213.1	1765.0	1541.4	1395.9	1093.5	848.9	654.3	502.0	384.3	3665.6
ENTHALPY (-)	-15.82	18.39	46.08	68.39	86.25	94.91	100.44	111.61	120.32	127.06	132.24	136.21	7.53
CP	.4347	.4264	.4167	.4051	.3914	.3831	.3767	.3622	.3504	.3426	.3381	.3361	.4295
IMPUL OPT	172.51	232.06	270.66	297.98	310.37	318.02	332.95	344.14	352.56	358.89	363.67	363.67	142.53
IMPUL VAC	256.69	282.60	305.46	323.19	331.50	336.70	346.93	354.64	360.46	364.85	368.17	368.17	251.99
EPSILON	1.053	1.587	2.745	4.996	7.159	9.299	17.478	32.974	62.317	117.980	223.898	1.000	

	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	569.1
PROSSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	569.1
TEMP, DEG K	4205.9	3784.4	3405.9	3053.3	2706.1	2497.7	2343.2	1963.7	1603.0	1288.4	1024.2	806.4	3941.9
ENTHALPY (-)	-15.82	19.69	50.87	78.29	102.33	114.84	123.15	140.80	155.34	167.13	176.54	183.99	6.46
X BAR	4.923	4.798	4.688	4.596	4.526	4.498	4.484	4.468	4.465	4.465	4.465	4.465	4.845
N	4.923	4.798	4.688	4.596	4.526	4.498	4.484	4.468	4.465	4.465	4.465	4.465	4.845
CP	1.3497	1.2578	1.1198	.9354	.7241	.6082	.5378	.4302	.3860	.3640	.3485	.3360	1.2985
IMPUL OPT	175.75	240.86	286.13	320.60	337.14	347.70	369.11	385.88	398.94	409.07	416.92	416.92	139.22
IMPUL VAC	265.07	298.17	328.53	353.62	365.95	373.82	389.66	401.91	411.40	418.74	424.39	424.39	257.82
EPSILON	1.077	1.735	3.225	6.310	9.407	12.517	24.772	48.556	94.814	184.621	358.254	1.000	

	18.86 F	.1305	.0738	.0382	.0174	.0064	.0030	.0016	.0002	.0000	.0000	.0000	.0000	.0929
COMPOSITION SHIFTING (MOL/100 GM)	18.86 F	.1305	.0738	.0382	.0174	.0064	.0030	.0016	.0002	.0000	.0000	.0000	.0000	.0929
-64.50 F=H	-64.50 F=H	2.4619	2.5188	2.5544	2.5751	2.5862	2.5896	2.5910	2.5924	2.5926	2.5926	2.5926	2.5926	2.4996
-26.10 F=H=O	-26.10 F=H=O	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
58.60 F=N	58.60 F=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-15.70 F=N=O	-15.70 F=N=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F=O	32.40 F=O	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	52.10 H	.2197	.1455	.0856	.0413	.0140	.0057	.0025	.0001	.0000	.0000	.0000	.0000	.1727
19.20 H=N	19.20 H=N	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-10.00 H=N=O	-10.00 H=N=O	.0049	.0036	.0025	.0016	.0009	.0006	.0005	.0002	.0000	.0000	.0000	.0000	.0041
9.33 H=O	9.33 H=O	.2797	.2422	.1956	.1418	.0857	.0558	.0374	.0097	.0013	.0001	.0000	.0000	.2579
.00 H2	.00 H2	.1340	.1049	.0755	.0469	.0222	.0117	.0064	.0008	.0000	.0000	.0000	.0000	.1162
40.30 H2=N	40.30 H2=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2=O	-57.80 H2=O	.2549	.3122	.3777	.4454	.5065	.5347	.5501	.5702	.5752	.5759	.5759	.5759	.2888
-11.04 H3=N	-11.04 H3=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	113.00 N	.0009	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005
21.65 N=O	21.65 N=O	.1352	.1117	.0880	.0651	.0436	.0320	.0244	.0102	.0029	.0006	.0001	.0000	.1209
8.06 N=O2	8.06 N=O2	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
.00 N2	.00 N2	.8653	.8782	.8908	.9027	.9138	.9198	.9237	.9309	.9346	.9358	.9361	.9361	.8732
19.50 N2=O	19.50 N2=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	59.56 O	.2502	.1875	.1271	.0742	.0335	.0173	.0094	.0012	.0001	.0000	.0000	.0000	.2119
.00 O2	.00 O2	.1855	.2194	.2526	.2841	.3130	.3280	.3373	.3525	.3584	.3599	.3602	.3602	.2062

SYSTEM LIQUID BIPHROPELLANT										PC 1000, PSIA					
COMPONENT										DENSITY					
TRIP FORMULA										HEAT FORM					
DEG K										[KCAL/FORM.WT.]					
128 O2F2										70.					
298 N2H4										12.05					
FROZEN EXPANSION										C STAR = 4463.9 FT/SEC					
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL / I	OPT DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC	CF SEA	CF VAC
			DEG K	KCAL/100GM	GM DEG		/P	LVL	10000	50000		LVL			
1.000	1.000	1000.000	4205.9	15.82	.435										
2.000	1.015	944.339	3685.6	-7.53	.429	142.5	109.5	.201	249.0	249.9	251.7	252.0	1.240	1.254	
3.000	10.113	96.963	2493.0	-56.98	.412	252.3	41.2	.425	287.3	289.2	292.8	293.5	1.430	1.461	
4.000	18.429	54.261	2138.6	-71.40	.403	275.5	33.0	.408	299.6	302.2	307.5	308.5	1.491	1.536	
5.000	29.155	34.253	1917.7	-80.24	.397	289.1	28.2	.422	305.2	308.9	315.9	317.3	1.519	1.579	
6.000	39.865	25.085	1764.4	-86.28	.391	298.0	25.2	1.005	308.5	312.9	321.5	323.2	1.559	1.609	
7.000	52.555	18.026	1647.5	-90.83	.387	304.6	23.0	1.210	309.8	315.2	325.5	327.6	1.582	1.631	
8.000	65.870	13.182	1554.6	-94.41	.384	309.7	21.4	1.407	310.3	316.6	328.6	331.0	1.585	1.648	
9.000	80.268	12.498	1478.0	-97.33	.380	313.7	20.0	1.609		317.3	331.0	333.8		1.661	
10.000	95.352	10.483	1411.3	-99.78	.377	317.1	19.0	1.809		317.5	333.0	336.1		1.673	
11.000	111.526	9.767	1357.6	-101.88	.375	320.0	18.1	2.014		316.6	338.0			1.683	
12.000	128.122	7.770	1306.9	-103.70	.373	322.4	17.3	2.223		315.9	339.7			1.691	
13.000	146.612	6.821	1265.7	-105.30	.371	324.6	16.6	2.433		317.0	341.2			1.698	
14.000	165.003	6.057	1227.2	-106.72	.369	326.5	16.0	2.640		338.0	342.5			1.705	
15.000	183.900	5.435	1192.4	-108.00	.367	328.2	15.5	2.844		338.8	343.7			1.711	
16.000	203.162	4.922	1160.9	-109.16	.366	329.0	15.0	3.044		339.5	344.7			1.716	
17.000	222.455	4.496	1132.0	-110.21	.364	331.1	14.5	3.237		340.1	345.7			1.721	
18.000	241.902	4.134	1105.5	-111.18	.363	332.4	14.2	3.424		340.7	346.5			1.725	
19.000	262.746	3.806	1080.9	-112.06	.362	333.5	13.8	3.624		341.2	347.3			1.729	
20.000	285.181	3.504	1058.2	-112.89	.360	334.6	13.5	3.841		341.5	348.1			1.733	
21.000	308.605	3.220	1036.9	-113.65	.359	335.6	13.1	4.058		341.8	348.8			1.736	
22.000	332.339	3.004	1017.1	-114.37	.358	336.5	12.9	4.274		342.1	349.4			1.739	
23.000	356.507	2.805	998.5	-115.03	.358	337.4	12.6	4.489		342.3	350.0			1.742	
24.000	381.028	2.624	981.0	-115.66	.357	338.2	12.3	4.701		342.5	350.5			1.745	
25.000	405.826	2.466	964.5	-116.26	.356	339.0	12.1	4.913		342.7	351.1			1.747	
26.000	430.829	2.321	948.9	-116.80	.355	339.7	11.9	5.121		342.8	351.6			1.750	
27.000	455.969	2.193	934.1	-117.32	.354	340.3	11.7	5.325		342.9	352.0			1.752	
28.000	481.193	2.078	920.1	-117.82	.354	341.0	11.5	5.525		343.0	352.4			1.754	
29.000	506.418	1.975	906.7	-118.29	.353	341.6	11.3	5.721		343.1	352.9			1.756	
30.000	531.627	1.881	894.1	-118.74	.352	342.1	11.1	5.912		343.2	353.3			1.758	
31.000	556.774	1.796	881.9	-119.16	.352	342.7	11.0	6.098		343.2	353.6			1.760	
32.000	581.810	1.719	870.4	-119.57	.351	343.2	10.8	6.280		343.3	354.0			1.762	
33.000	606.777	1.648	859.1	-119.96	.351	343.7	10.6	6.457		343.3	354.3			1.764	
34.000	631.718	1.583	848.7	-120.33	.350	344.2	10.5	6.630		343.3	354.6			1.765	
35.000	656.601	1.513	838.5	-120.69	.350	344.6	10.4	6.806		343.3	354.9			1.767	
36.000	681.466	1.447	828.7	-121.03	.349	345.0	10.2	7.062		343.3	355.3			1.768	
37.000	706.271	1.387	819.3	-121.36	.349	345.5	10.1	7.278		343.3	355.6			1.770	
38.000	731.074	1.330	810.2	-121.68	.348	345.9	10.0	7.495		343.3	355.9			1.771	
39.000	755.878	1.277	801.5	-121.98	.348	346.2	9.9	7.711		343.3	356.1			1.772	
40.000	780.681	1.228	793.0	-122.28	.348	346.6	9.7	7.927		343.3	356.3			1.774	
41.000	805.484	1.182	784.9	-122.56	.348	347.0	9.6	8.143		343.3	356.6			1.775	
42.000	830.287	1.139	777.0	-122.83	.347	347.3	9.5	8.358		343.3	356.8			1.776	
43.000	855.090	1.099	769.4	-123.10	.347	347.6	9.4	8.572		343.3	357.1			1.777	
44.000	879.893	1.061	762.1	-123.35	.347	348.0	9.3	8.785		343.3	357.3			1.778	
45.000	904.696	1.025	754.9	-123.60	.346	348.3	9.2	8.997		343.3	357.5			1.779	
46.000	929.499	.992	748.0	-123.84	.346	348.6	9.1	9.204		343.3	357.7			1.780	
47.000	954.302	.960	741.3	-124.07	.346	348.9	9.0	9.411		343.3	357.9			1.781	
48.000	979.105	.931	734.8	-124.30	.346	349.1	9.0	9.623		343.3	358.1			1.782	
49.000	1003.908	.903	728.5	-124.51	.345	349.4	8.9	9.829		343.3	358.3			1.783	
50.000	1028.711	.876	722.4	-124.72	.345	349.7	8.8	10.032		343.3	358.5			1.784	
51.000	1053.514	.851	716.4	-124.93	.345	349.9	8.7	10.233		343.3	358.6			1.785	
52.000	1078.317	.826	710.4	-125.14	.345	350.2	8.7	10.434		343.3	358.7			1.786	
53.000	1103.120	.801	704.4	-125.35	.345	350.4	8.6	10.635		343.3	358.8			1.787	
54.000	1127.923	.776	698.4	-125.56	.345	350.6	8.5	10.836		343.3	358.9			1.788	
55.000	1152.726	.751	692.4	-125.77	.345	350.8	8.4	11.037		343.3	359.0			1.789	
56.000	1177.529	.726	686.4	-125.98	.345	351.0	8.3	11.238		343.3	359.1			1.790	
57.000	1202.332	.701	680.4	-126.19	.345	351.2	8.2	11.439		343.3	359.2			1.791	
58.000	1227.135	.676	674.4	-126.40	.345	351.4	8.1	11.640		343.3	359.3			1.792	
59.000	1251.938	.651	668.4	-126.61	.345	351.6	8.0	11.841		343.3	359.4			1.793	
60.000	1276.741	.626	662.4	-126.82	.345	351.8	7.9	12.042		343.3	359.5			1.794	
61.000	1301.544	.601	656.4	-127.03	.345	352.0	7.8	12.243		343.3	359.6			1.795	
62.000	1326.347	.576	650.4	-127.24	.345	352.2	7.7	12.444		343.3	359.7			1.796	
63.000	1351.150	.551	644.4	-127.45	.345	352.4	7.6	12.645		343.3	359.8			1.797	
64.000	1375.953	.526	638.4	-127.66	.345	352.6	7.5	12.846		343.3	359.9			1.798	
65.000	1400.756	.501	632.4	-127.87	.345	352.8	7.4	13.047		343.3	360.0			1.799	
66.000	1425.559	.476	626.4	-128.08	.345	353.0	7.3	13.248		343.3	360.1			1.800	
67.000	1450.362	.451	620.4	-128.29	.345	353.2	7.2	13.449		343.3	360.2			1.801	
68.000	1475.165	.426	614.4	-128.50	.345	353.4	7.1	13.650		343.3	360.3			1.802	
69.000	1500.000	.401	608.4	-128.71	.345	353.6	7.0	13.851		343.3	360.4			1.803	
70.000	1524.800	.376	602.4	-128.92	.345	353.8	6.9	14.052		343.3	360.5			1.804	
71.000	1549.600	.351	596.4	-129.13	.345	354.0	6.8	14.253		343.3	360.6			1.805	
72.000	1574.400	.326	590.4	-129.34	.345	354.2	6.7	14.454		343.3	360.7			1.806	
73.000	1599.200	.301	584.4	-129.55	.345	354.4	6.6	14.655		343.3	360.8			1.807	
74.000	1624.000	.276	578.4	-129.76	.345	354.6	6.5	14.856		343.3	360.9			1.808	
75.000	1648.800	.251	572.4	-129.97	.345	354.8	6.4	15.057		343.3	361.0			1.809	
76.000	1673.600	.226	566.4	-130.18	.345	355.0	6.3	15.258		343.3	361.1			1.810	
77.000	1698.400	.201	560.4	-130.39	.345	355.2	6.2	15.459		343.3	361.2			1.811	
78.000	1723.200	.176	554.4	-130.60	.345	355.4	6.1	15.660		343.3	361.3			1.812	
79.000	1748.000	.151	548.4	-130.81	.345	355.6	6.0	15.861		343.3	361.4			1.813	
80.000	1772.800	.126	542.4	-131.02	.345	355.8	5.9	16.062		343.3	361.5			1.814	
81.000	1797.600	.101	536.4	-131.23	.345	356.0	5.8	16.263		343.3	361.6			1.815	
82.000	1822.400	.076	530.4	-131.44	.345	356.2	5.7	16.464		343.3	361.7			1.816	
83.000	1847.200	.051	524.4	-131.65	.345	356.4	5.6	16.665		343.3	361.8			1.817	
84.000	1872.000	.026	518.4	-131.86	.345	356.6	5.5	16.866		343.3	361.9			1.818	
85.000	1896.800	.001	512.4												

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. G/G
 DEG K GM/CC (KCAL/FORM.WT.)
 128 O*F2 1.53 +3.5 44.
 298 N2*H4 1.004 +12.05 56.

BULK DENSITY = 1.183 GM/CC
 MIXTURE RATIO = .786 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 345.80 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	164.7
TEMP, DEG K	3319.9	2791.6	2337.7	1947.8	1686.6	1613.4	1327.0	1083.3	877.9	707.1	566.7	452.8	2916.8
ENTHALPY (-)	-23.91	6.33	31.71	52.92	66.72	70.53	85.07	96.99	106.69	114.52	120.82	125.86	-7.77
CP	.5780	.5659	.5515	.5354	.5215	.5173	.4980	.4801	.4645	.4528	.4447	.4402	.5691
IMPUL OPT	162.19	219.96	258.52	280.79	286.62	307.91	324.31	337.06	347.03	354.83	360.96	367.72	252.66
IMPUL VAC	254.94	277.24	299.12	313.16	316.96	331.13	342.31	351.10	358.01	363.44	367.72	372.56	252.66
EPSILON	1.024	1.408	2.222	3.275	3.697	6.304	10.881	18.894	32.916	57.460	100.493	1.000	
	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	169.2
TEMP, DEG K	3319.9	2958.9	2593.8	2225.1	1952.0	1872.9	1558.0	1285.3	1052.3	855.3	691.1	555.8	3061.7
ENTHALPY (-)	-23.91	7.01	34.04	57.33	72.77	77.06	93.56	107.23	118.46	127.63	135.05	141.04	-1.39
X BAR	6.233	6.147	6.091	6.065	6.059	6.058	6.057	6.057	6.057	6.057	6.057	6.057	6.169
N	6.233	6.147	6.091	6.065	6.059	6.058	6.057	6.057	6.057	6.057	6.057	6.057	6.169
CP	1.1376	.9151	.7237	.5988	.5491	.5393	.5119	.4908	.4731	.4580	.4466	.4395	.9771
IMPUL OPT	163.99	224.52	265.84	290.01	296.38	319.67	337.76	351.93	363.08	371.87	378.81	389.96	
IMPUL VAC	259.88	285.35	309.73	325.27	329.47	345.19	357.68	367.58	375.41	381.60	386.49	396.62	
EPSILON	1.032	1.459	2.343	3.479	3.935	6.757	11.750	20.559	36.072	63.368	111.405	1.000	
	COMPOSITION SHIFTING (MOL/100 GM)												
18.86 F	.0030	.0009	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0013
-64.50 F*H	1.6266	1.6287	1.6295	1.6296	1.6296	1.6296	1.6296	1.6296	1.6296	1.6296	1.6296	1.6296	1.6283
-26.10 F*H*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
58.60 F*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-15.70 F*N*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.2808	.1522	.0615	.0159	.0039	.0024	.0002	.0000	.0000	.0000	.0000	.0000	.1855
19.20 H*N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-10.00 H*N*O	.0012	.0005	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0006
9.33 H*O	.0517	.0223	.0064	.0010	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0293
.00 H2	1.7653	1.8045	1.8384	1.8577	1.8633	1.8640	1.8650	1.8651	1.8651	1.8651	1.8650	1.8646	1.7933
40.30 H2*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2*O	.7492	.7884	.8076	.8137	.8146	.8147	.8148	.8148	.8148	.8148	.8148	.8148	.7794
-11.04 H3*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	.0004	.0000
113.00 N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
21.65 N*O	.0064	.0021	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0030
8.06 N*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	1.7435	1.7460	1.7471	1.7473	1.7474	1.7474	1.7474	1.7474	1.7474	1.7474	1.7473	1.7472	1.7455
19.50 N2*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.0047	.0011	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0018
.00 O2	.0008	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003

SYSTEM LIQUID PROPELLANT										PC 300, PSIA									
COMPONENT										DENSITY									
TREF FORMULA										HEAT FORM									
DEG K										[KCAL/FORM.WT.]									
120 00F2										1.53 +1.5									
298 N20M4										1.004 +12.05									
FROZEN EXPANSION										C STAR = 6492.5 FT/SEC									
C CAL / I NPT DELVAC DFLVAC										I SEA I AT I AT I VAC CF SEA CF VAC									
EPI SILON PC/F P PSIA TEMP ENTHALPY CP CAL / I NPT DELVAC DFLVAC										LVL 10000 50000 LVL									
1.000 1.000 300.000 3319.9 23.91 .578										110.8 .673 247.8 245.8 251.5 252.7 1.203 1.252									
1.000	1.000	300.000	3319.9	23.91	.578					110.8	.673	247.8	245.8	251.5	252.7	1.203	1.252		
2.000	1.821	30.581	2021.8	-48.97	.539	252.3	42.5	1.391	276.4	280.5	282.4	286.8	286.8	286.8	286.8	1.380	1.481		
3.000	17.481	18.789	1741.8	-63.85	.525	276.3	33.9	2.024	280.5	289.5	306.8	310.3	310.3	310.3	310.3	1.390	1.538		
4.000	27.770	10.803	1567.6	-72.89	.514	280.2	29.1	2.694	291.6	314.7	319.3	319.3	319.3	319.3	319.3	1.582			
5.000	39.052	7.482	1444.7	-79.16	.506	299.5	26.0	3.383	319.7	325.4	325.4	325.4	325.4	325.4	325.4	1.613			
6.000	51.055	5.876	1351.4	-83.86	.500	306.2	23.8	4.047	323.1	330.0	330.0	330.0	330.0	330.0	330.0	1.635			
7.000	64.128	4.866	1276.7	-87.57	.494	311.4	22.1	4.736	325.4	333.5	333.5	333.5	333.5	333.5	333.5	1.655			
8.000	78.737	4.102	1215.1	-90.61	.490	315.6	20.7	5.482	327.1	336.4	336.4	336.4	336.4	336.4	336.4	1.687			
9.000	93.619	3.206	1163.0	-93.15	.486	319.1	19.6	6.176	328.3	338.8	338.8	338.8	338.8	338.8	338.8	1.679			
10.000	108.089	2.760	1118.1	-95.32	.483	322.1	18.7	6.776	329.2	340.8	340.8	340.8	340.8	340.8	340.8	1.689			
11.000	124.054	2.419	1076.8	-97.21	.480	324.6	17.9	7.403	329.9	342.5	342.5	342.5	342.5	342.5	342.5	1.687			
12.000	141.151	2.122	1044.0	-98.87	.477	326.8	17.2	8.012	330.2	344.0	344.0	344.0	344.0	344.0	344.0	1.705			
13.000	159.407	1.882	1012.8	-100.36	.475	328.8	16.6	8.619	330.3	345.4	345.4	345.4	345.4	345.4	345.4	1.712			
14.000	177.904	1.686	984.7	-101.69	.473	330.6	16.0	9.218	330.6	346.6	346.6	346.6	346.6	346.6	346.6	1.718			
15.000	196.758	1.525	959.1	-102.89	.471	332.1	15.6	9.820	330.6	347.7	347.7	347.7	347.7	347.7	347.7	1.723			
16.000	216.059	1.390	935.8	-103.99	.469	333.8	15.1	10.424	330.7	348.7	348.7	348.7	348.7	348.7	348.7	1.728			
17.000	235.040	1.276	914.3	-105.00	.467	334.9	14.7	11.026	330.7	349.6	349.6	349.6	349.6	349.6	349.6	1.732			
18.000	254.322	1.179	894.4	-105.92	.466	336.1	14.3	11.639	330.4	350.4	350.4	350.4	350.4	350.4	350.4	1.737			
19.000	273.923	1.095	876.0	-106.78	.464	337.2	14.0	12.258	330.4	351.2	351.2	351.2	351.2	351.2	351.2	1.740			
20.000	293.762	1.024	858.8	-107.57	.463	338.2	13.7	12.891	330.4	351.9	351.9	351.9	351.9	351.9	351.9	1.744			
21.000	313.810	.961	842.8	-108.32	.462	339.2	13.4	13.524	330.4	352.6	352.6	352.6	352.6	352.6	352.6	1.747			
22.000	334.068	.900	827.7	-109.01	.461	340.1	13.1	14.160	330.4	353.2	353.2	353.2	353.2	353.2	353.2	1.750			
23.000	354.536	.843	813.6	-109.67	.460	340.9	12.9	14.806	330.4	353.7	353.7	353.7	353.7	353.7	353.7	1.753			
24.000	375.119	.791	800.2	-110.28	.459	341.7	12.6	15.464	330.4	354.3	354.3	354.3	354.3	354.3	354.3	1.756			
25.000	395.822	.742	787.6	-110.86	.458	342.4	12.4	16.134	330.4	354.8	354.8	354.8	354.8	354.8	354.8	1.758			
26.000	416.654	.699	775.6	-111.41	.457	343.1	12.2	16.817	330.4	355.3	355.3	355.3	355.3	355.3	355.3	1.761			
27.000	437.629	.653	764.3	-111.92	.457	343.8	12.0	17.504	330.4	355.7	355.7	355.7	355.7	355.7	355.7	1.763			
28.000	458.848	.620	753.5	-112.42	.456	344.4	11.8	18.202	330.4	356.2	356.2	356.2	356.2	356.2	356.2	1.765			
29.000	480.319	.590	743.2	-112.89	.455	345.0	11.6	18.914	330.4	356.6	356.6	356.6	356.6	356.6	356.6	1.767			
30.000	502.043	.563	733.3	-113.33	.454	345.5	11.4	19.640	330.4	357.0	357.0	357.0	357.0	357.0	357.0	1.769			
31.000	523.921	.538	724.0	-113.76	.454	346.1	11.3	20.384	330.4	357.3	357.3	357.3	357.3	357.3	357.3	1.771			
32.000	546.053	.515	715.0	-114.16	.453	346.6	11.1	21.158	330.4	357.7	357.7	357.7	357.7	357.7	357.7	1.773			
33.000	568.423	.494	706.4	-114.55	.453	347.1	11.0	21.952	330.4	358.0	358.0	358.0	358.0	358.0	358.0	1.774			
34.000	591.047	.471	698.1	-114.91	.452	347.5	10.8	22.769	330.4	358.4	358.4	358.4	358.4	358.4	358.4	1.776			
35.000	613.921	.453	690.2	-115.25	.452	348.0	10.7	23.612	330.4	358.7	358.7	358.7	358.7	358.7	358.7	1.777			
36.000	637.043	.436	682.5	-115.63	.451	348.4	10.6	24.484	330.4	359.0	359.0	359.0	359.0	359.0	359.0	1.779			
37.000	660.413	.417	675.2	-115.96	.451	348.8	10.4	25.382	330.4	359.3	359.3	359.3	359.3	359.3	359.3	1.780			
38.000	684.043	.401	668.1	-116.28	.450	349.2	10.1	26.304	330.4	359.6	359.6	359.6	359.6	359.6	359.6	1.782			
39.000	707.921	.386	661.3	-116.59	.450	349.6	10.2	26.424	330.4	359.8	359.8	359.8	359.8	359.8	359.8	1.783			
40.000	732.043	.371	654.7	-116.89	.450	350.0	10.1	27.135	330.4	360.1	360.1	360.1	360.1	360.1	360.1	1.784			
41.000	756.413	.355	648.3	-117.18	.449	350.3	10.0	27.834	330.4	360.3	360.3	360.3	360.3	360.3	360.3	1.786			
42.000	781.043	.340	642.1	-117.45	.449	350.7	9.9	28.534	330.4	360.5	360.5	360.5	360.5	360.5	360.5	1.787			
43.000	805.921	.326	636.2	-117.72	.448	351.0	9.8	29.221	330.4	360.8	360.8	360.8	360.8	360.8	360.8	1.788			
44.000	831.043	.313	630.4	-117.98	.448	351.3	9.7	29.909	330.4	361.0	361.0	361.0	361.0	361.0	361.0	1.789			
45.000	856.413	.301	624.8	-118.23	.448	351.6	9.6	30.594	330.4	361.2	361.2	361.2	361.2	361.2	361.2	1.790			
46.000	882.043	.289	619.3	-118.47	.447	351.9	9.5	31.271	330.4	361.4	361.4	361.4	361.4	361.4	361.4	1.791			
47.000	907.921	.278	614.0	-118.71	.447	352.2	9.4	31.942	330.4	361.6	361.6	361.6	361.6	361.6	361.6	1.792			
48.000	934.043	.265	608.9	-118.94	.447	352.5	9.3	32.613	330.4	361.8	361.8	361.8	361.8	361.8	361.8	1.793			
49.000	960.413	.253	603.9	-119.16	.447	352.8	9.2	33.276	330.4	362.0	362.0	362.0	362.0	362.0	362.0	1.794			
50.000	987.043	.243	599.1	-119.38	.446	353.1	9.1	33.933	330.4	362.2	362.2	362.2	362.2	362.2	362.2	1.795			
3.275	20.414	14.496	1888.6	-68.72	.522	280.8	32.4	2.201	280.8	290.5	309.4	313.2	1.391	1.552					

SHIFTING EXPANSION														
C STAR = 6655.7 FT/SEC														
EPSILON	PC/F	P PSIA	TEMP	ENTHALPY	CP CAL/I	NPT	DELVAC	DELVAC	I SFA	I AT	I AT	I VAC	CF SEA	CF VAC
			DEG F	KCAL/1000G	CM	DEG	/P	/P	LVL	10000	50000			
1.000	1.000	300.000	3319.9	23.91	.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1.000	1.713	1649.100	1061.7	-1.39	.077	145.0	116.7	.690	246.5	249.5	255.4	256.6	1.241	1.192
2.000	4.072	3.730	2337.8	-0.67	.028	250.3	47.3	1.430	281.6	287.9	300.1	102.6	1.761	1.645
3.000	16.332	18.746	2050.9	-77.32	.564	281.7	38.1	2.077	289.3	278.5	316.3	319.8	1.546	1.546
4.000	25.216	11.897	1862.5	-77.62	.538	297.2	32.8	2.757	321.5	327.7	325.9	330.0	1.500	1.500
5.000	35.163	8.483	1727.0	-86.81	.528	327.0	27.0	3.438	351.0	357.0	331.0	337.0	1.479	1.479
6.000	46.273	6.483	1622.9	-90.23	.516	351.1	27.0	4.158	375.0	381.0	335.0	342.1	1.654	1.654
7.000	57.767	5.191	1539.2	-94.52	.510	321.0	25.1	4.836	438.0	444.0	337.0	346.1	1.673	1.673
8.000	70.684	4.244	1469.8	-98.06	.505	325.7	23.6	5.565	439.0	445.0	343.0	349.3	1.689	1.689
9.000	84.122	3.766	1411.0	-101.00	.500	322.0	22.4	6.301	451.0	457.0	343.3	349.5	1.700	1.700
10.000	97.817	3.368	1380.1	-103.94	.496	335.0	21.4	6.973	463.0	469.0	342.5	349.4	1.713	1.713
11.000	111.640	2.687	1315.4	-105.75	.493	335.9	20.5	7.631	463.3	469.6	343.3	350.4	1.723	1.723
12.000	125.889	2.383	1275.8	-107.69	.490	338.4	19.7	8.283	464.0	470.3	344.0	351.1	1.731	1.731
13.000	141.782	2.116	1240.2	-109.44	.487	340.6	19.1	8.910	464.3	470.6	344.3	351.7	1.739	1.739
14.000	158.197	1.948	1208.0	-111.00	.484	342.8	18.4	9.537	464.6	470.9	344.6	352.3	1.747	1.747
15.000	175.006	1.716	1178.7	-112.42	.483	344.4	17.9	10.162	464.9	471.2	344.9	352.3	1.751	1.751
16.000	192.104	1.562	1151.8	-113.72	.481	346.0	17.4	11.151	465.0	471.3	345.0	352.4	1.757	1.757
17.000	209.462	1.433	1127.0	-114.90	.479	347.7	17.0	11.851	465.1	471.4	345.1	352.5	1.762	1.762
18.000	226.862	1.323	1104.1	-116.00	.477	349.3	16.7	12.551	465.2	471.5	345.2	352.6	1.767	1.767
19.000	244.310	1.228	1082.8	-117.02	.475	350.1	16.7	13.185	465.3	471.6	345.3	352.7	1.771	1.771
20.000	261.830	1.146	1062.6	-117.96	.474	351.3	15.8	13.862	465.4	471.7	345.4	352.8	1.775	1.775
21.000	280.274	1.070	1044.2	-118.84	.473	352.4	15.5	14.495	465.5	471.8	345.5	352.9	1.779	1.779
22.000	300.184	.999	1026.7	-119.67	.471	353.5	15.2	15.220	465.6	471.9	345.6	353.0	1.782	1.782
23.000	320.497	.932	1010.1	-120.45	.470	354.6	14.9	15.945	465.7	472.0	345.7	353.1	1.786	1.786
24.000	341.153	.874	994.5	-121.18	.469	355.3	14.7	16.667	465.8	472.1	345.8	353.2	1.788	1.788
25.000	362.125	.828	979.8	-121.87	.467	356.1	14.4	17.387	465.9	472.2	345.9	353.3	1.790	1.790
26.000	383.166	.783	965.7	-122.52	.466	356.9	14.2	18.103	466.0	472.3	346.0	353.4	1.794	1.794
27.000	404.615	.740	952.1	-123.15	.465	357.7	13.9	18.819	466.1	472.4	346.1	353.5	1.796	1.796
28.000	426.456	.703	939.7	-123.74	.464	358.4	13.7	19.516	466.2	472.5	346.2	353.6	1.799	1.799
29.000	448.313	.669	927.6	-124.30	.463	359.1	13.5	20.212	466.3	472.6	346.3	353.7	1.801	1.801
30.000	470.275	.638	916.1	-124.83	.463	359.7	13.3	20.899	466.4	472.7	346.4	353.8	1.803	1.803
31.000	492.295	.609	905.0	-125.34	.462	360.3	13.1	21.578	466.5	472.8	346.5	353.9	1.805	1.805
32.000	514.464	.582	894.4	-125.83	.461	360.9	12.9	22.257	466.6	472.9	346.6	354.0	1.807	1.807
33.000	536.780	.559	884.2	-126.30	.460	361.5	12.8	22.900	466.7	473.0	346.7	354.1	1.809	1.809
34.000	558.793	.537	874.4	-126.75	.459	362.0	12.6	23.556	466.8	473.1	346.8	354.2	1.811	1.811
35.000	581.019	.516	865.0	-127.18	.459	362.5	12.5	24.197	466.9	473.2	346.9	354.3	1.813	1.813
36.000	603.316	.497	856.0	-127.59	.458	363.0	12.4	24.830	467.0	473.3	347.0	354.4	1.815	1.815
37.000	627.933	.477	847.2	-127.98	.457	363.5	12.2	25.544	467.1	473.4	347.1	354.5	1.816	1.816
38.000	653.035	.459	838.8	-128.38	.457	364.0	12.1	26.262	467.2	473.5	347.2	354.6	1.818	1.818
39.000	678.433	.442	830.7	-128.75	.456	364.4	11.9	26.991	467.3	473.6	347.3	354.7	1.819	1.819
40.000	704.111	.426	822.8	-129.11	.456	364.9	11.8	27.715	467.4	473.7	347.4	354.8	1.821	1.821
41.000	730.050	.410	815.2	-129.45	.455	365.3	11.6	28.439	467.5	473.8	347.5	354.9	1.822	1.822
42.000	756.234	.397	807.9	-129.79	.454	365.7	11.6	29.160	467.6	473.9	347.6	355.0	1.824	1.824
43.000	782.445	.383	800.7	-130.12	.454	366.1	11.5	29.880	467.7	474.0	347.7	355.1	1.825	1.825
44.000	809.265	.371	793.8	-130.43	.453	366.4	11.3	30.598	467.8	474.1	347.8	355.2	1.826	1.826
45.000	836.079	.359	787.1	-130.73	.453	366.8	11.2	31.316	467.9	474.2	347.9	355.3	1.827	1.827
46.000	863.000	.348	780.6	-131.01	.452	367.1	11.1	32.027	468.0	474.3	348.0	355.4	1.828	1.828
47.000	890.223	.337	774.3	-131.31	.452	367.5	11.0	32.737	468.1	474.4	348.1	355.5	1.830	1.830
48.000	917.522	.327	768.1	-131.59	.452	367.8	10.9	33.443	468.2	474.5	348.2	355.6	1.831	1.831
49.000	944.951	.317	762.2	-131.86	.451	368.1	10.8	34.145	468.3	474.6	348.3	355.7	1.832	1.832
50.000	972.500	.307	756.5	-132.12	.451	368.4	10.7	34.847	468.4	474.7	348.4	355.8	1.833	1.833
347.3	270.515	1.4996	1752.0	-72.77	.549	289.0	35.3	2.899	290.0	300.6	321.2	323.3	1.402	1.572

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. G/G
 DEG K GM/CC (KCAL/FORM.WT.)
 128 O=F2 1.53 +3.5 50.
 298 N2=H4 1.004 +12.05 50.

BULK DENSITY = 1.212 GM/CC
 MIXTURE RATIO = 1.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 335.13 EU/100GMS

	CHAMBER											THROAT	
	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	164.4
TEMP, DEG K	3559.2	2992.3	2506.1	2089.4	1810.5	1732.2	1426.8	1166.4	946.4	762.7	611.5	488.3	3125.4
ENTHALPY (-)	-22.04	8.68	34.47	56.02	70.07	73.94	88.75	100.91	110.81	118.82	125.25	130.41	1.52
CP	.5471	.5362	.5241	.5096	.4972	.4933	.4755	.4579	.4422	.4299	.4212	.4159	.5392
IMPUL OPT	163.48	221.73	260.59	283.07	288.96	310.46	327.05	339.96	350.06	357.96	364.17	364.17	143.18
IMPUL VAC	256.98	279.46	301.55	315.74	319.59	333.93	345.26	354.18	361.19	366.69	371.07	371.07	254.68
EPSILON	1.023	1.407	2.223	3.278	3.702	6.320	10.922	18.987	33.095	57.779	101.006	1.000	

	SHIFTING EXPANSION												
	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	170.1
TEMP, DEG K	3559.2	3232.0	2908.7	2574.2	2307.0	2225.1	1881.7	1570.1	1298.8	1066.0	868.6	703.2	3326.1
ENTHALPY (-)	-22.04	9.56	37.66	62.42	79.20	83.92	102.24	117.60	130.37	140.89	149.50	156.48	.74
X BAR	5.909	5.796	5.707	5.647	5.622	5.617	5.608	5.607	5.606	5.606	5.606	5.606	5.826
N	5.909	5.796	5.707	5.647	5.622	5.617	5.608	5.607	5.606	5.606	5.606	5.606	5.826
CP	1.4448	1.2133	.9548	.7282	.6061	.5795	.5101	.4807	.4605	.4435	.4284	.4171	1.2856
IMPUL OPT	165.81	227.89	271.07	296.78	303.61	328.81	348.55	364.13	376.49	386.30	394.09	394.09	140.78
IMPUL VAC	263.48	290.86	317.43	334.56	339.20	356.56	370.38	381.42	390.21	397.20	402.74	402.74	259.79
EPSILON	1.036	1.488	2.440	3.675	4.171	7.241	12.691	22.377	39.560	69.955	123.636	1.000	

	COMPOSITION SHIFTING (MOL/100 GM)												
18.86 F	.0098	.0042	.0014	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0055
-64.50 F=H	1.8420	1.8477	1.8505	1.8516	1.8518	1.8518	1.8519	1.8519	1.8519	1.8519	1.8519	1.8519	1.8464
-26.10 F=H=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
58.60 F=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-15.70 F=N=C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.3941	.2655	.1531	.0670	.0266	.0188	.0030	.0003	.0000	.0000	.0000	.0000	.3015
19.20 H=N	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-10.00 H=N=C	.0022	.0012	.0005	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0015
9.33 H=O	.1230	.0747	.0356	.0115	.0033	.0021	.0002	.0000	.0000	.0000	.0000	.0000	.0881
.00 H2	1.1932	1.2006	1.2187	1.2425	1.2572	1.2603	1.2671	1.2683	1.2685	1.2685	1.2685	1.2684	1.1974
40.30 H2=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2=O	.7463	.8251	.8817	.9127	.9223	.9237	.9257	.9259	.9259	.9259	.9259	.9259	.8041
-11.04 H3=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
21.65 N=O	.0200	.0100	.0038	.0009	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0125
8.06 N=O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	1.5488	1.5545	1.5580	1.5596	1.5600	1.5601	1.5602	1.5602	1.5602	1.5602	1.5602	1.5602	1.5531
19.50 N2=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.0230	.0096	.0027	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0128
.00 O2	.0057	.0026	.0008	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0034

SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
COMPONENT TETRAFORMULA DENSITY HEAT FORM WT. 8/0
DEG K GR/CC (KCAL/FORM.WT.) SC.
128 0.0P2 1.53 43.5
208 N2O4 1.004 112.05 SC.

FREEZE EXPANSION
C STAR = 8545.4 FT/SEC

EPSILON	PC/P	P PSIA	TEMP DEG K	ENTHALPY KCAL/100GM	CP CAL/ I UPT DEG K	DELTA VAC DELTA VAC /P	I SEA LVL	I AT 10000	I AT 50000	I VAC	CF SEA LVL	CF VAC
1.000	1.000	300.000	3559.2	22.04	547	143.2	111.5	244.7	247.7	253.5	254.7	1.203
1.000	1.824	184.433	3125.4	-1.32	539	143.2	111.5	244.7	247.7	253.5	254.7	1.203
2.000	9.807	30.590	2168.5	-51.99	513	254.3	42.9	1.403	276.6	282.8	294.8	1.359
3.000	17.862	18.796	1869.9	-67.10	500	278.5	34.3	2.041	282.8	291.8	309.3	1.390
4.000	27.709	10.827	1684.2	-76.31	491	292.5	29.4	2.716	294.0	317.3	321.9	1.502
5.000	38.943	7.704	1553.3	-82.88	483	301.8	26.3	3.411	302.3	322.3	328.1	1.613
6.000	50.880	5.896	1454.0	-87.46	477	308.8	24.1	4.081	305.7	325.7	332.7	1.635
7.000	64.051	4.486	1374.5	-91.23	472	313.9	22.4	4.774	308.1	328.1	336.3	1.653
8.000	78.368	3.828	1308.7	-94.32	468	318.2	21.0	5.486	309.8	329.8	339.2	1.667
9.000	93.159	3.220	1253.1	-96.91	464	321.7	19.9	6.176	311.1	331.6	341.6	1.679
10.000	108.117	2.774	1205.2	-99.13	461	324.7	19.0	6.833	312.0	332.6	342.6	1.689
11.000	123.283	2.433	1163.3	-101.05	458	327.2	18.2	7.462	312.7	333.4	343.4	1.698
12.000	140.531	2.135	1126.0	-102.75	455	329.5	17.5	8.176	313.0	334.9	344.9	1.705
13.000	158.424	1.894	1092.7	-104.26	453	331.5	16.8	8.889	313.2	336.3	346.3	1.712
14.000	176.762	1.697	1062.6	-105.62	451	333.3	16.3	9.594	314.0	337.5	347.5	1.718
15.000	195.471	1.535	1035.3	-106.85	449	334.9	15.8	10.287	314.7	338.7	348.7	1.724
16.000	214.416	1.399	1010.2	-107.97	447	336.3	15.3	10.964	315.1	339.7	349.7	1.729
17.000	233.904	1.285	987.2	-109.00	445	337.6	14.9	11.623	315.4	340.7	350.7	1.733
18.000	252.669	1.187	965.9	-109.95	444	338.8	14.6	12.263	315.6	341.6	351.6	1.737
19.000	271.904	1.103	946.2	-110.82	442	340.0	14.2	12.888	315.7	342.4	352.4	1.741
20.000	293.548	1.022	927.7	-111.64	441	341.0	13.9	13.507	315.8	343.2	353.2	1.745
21.000	315.700	.950	910.5	-112.40	440	342.0	13.6	14.110	315.9	344.0	354.0	1.748
22.000	338.303	.887	894.3	-113.11	439	342.9	13.3	14.701	316.0	344.8	354.8	1.751
23.000	361.299	.830	878.0	-113.78	438	343.7	13.1	15.270	316.1	345.6	355.6	1.754
24.000	384.633	.780	864.7	-114.40	437	344.5	12.9	15.824	316.2	346.4	356.4	1.757
25.000	408.253	.735	851.1	-115.00	436	345.3	12.6	16.372	316.3	347.2	357.2	1.759
26.000	432.107	.694	838.2	-115.56	435	346.0	12.4	16.912	316.4	348.0	358.0	1.762
27.000	456.152	.658	826.0	-116.09	434	346.7	12.2	17.450	316.5	348.8	358.8	1.764
28.000	480.344	.625	814.3	-116.59	433	347.3	12.0	17.978	316.6	349.6	359.6	1.766
29.000	504.656	.594	803.3	-117.07	433	347.9	11.8	18.509	316.7	350.4	360.4	1.768
30.000	529.093	.567	792.7	-117.53	432	348.5	11.6	19.039	316.8	351.2	361.2	1.770
31.000	553.515	.542	782.6	-117.97	431	349.0	11.5	19.562	316.9	352.0	362.0	1.772
32.000	578.029	.519	772.9	-118.38	431	349.5	11.3	20.078	317.0	352.8	362.8	1.774
33.000	602.585	.498	763.6	-118.78	430	350.0	11.1	20.584	317.1	353.6	363.6	1.775
34.000	627.183	.478	754.7	-119.16	429	350.5	11.0	21.084	317.2	354.4	364.4	1.777
35.000	651.815	.458	746.1	-119.53	429	350.9	10.9	21.578	317.3	355.2	365.2	1.778
36.000	676.473	.438	737.8	-119.89	428	351.4	10.7	22.061	317.4	356.0	366.0	1.780
37.000	701.153	.420	730.0	-120.23	428	351.8	10.6	22.534	317.5	356.8	366.8	1.781
38.000	725.853	.404	722.3	-120.55	427	352.2	10.5	23.009	317.6	357.6	367.6	1.783
39.000	750.573	.389	715.0	-120.87	427	352.6	10.4	23.478	317.7	358.4	368.4	1.784
40.000	775.313	.374	707.8	-121.17	427	353.0	10.2	23.931	317.8	359.2	369.2	1.785
41.000	800.073	.361	700.9	-121.47	426	353.3	10.1	24.378	317.9	360.0	370.0	1.787
42.000	824.853	.349	694.3	-121.75	426	353.7	10.0	24.818	318.0	360.8	370.8	1.788
43.000	849.653	.337	687.8	-122.02	425	354.0	9.9	25.250	318.1	361.6	371.6	1.789
44.000	874.473	.326	681.6	-122.29	425	354.3	9.8	25.678	318.2	362.4	372.4	1.790
45.000	899.313	.315	675.5	-122.55	425	354.7	9.7	26.101	318.3	363.2	373.2	1.791
46.000	924.173	.304	669.7	-122.80	424	355.0	9.6	26.518	318.4	364.0	374.0	1.792
47.000	949.053	.294	664.0	-123.04	424	355.3	9.5	26.928	318.5	364.8	374.8	1.793
48.000	973.953	.284	658.4	-123.27	424	355.5	9.5	27.331	318.6	365.6	375.6	1.794
49.000	1000.000	.274	653.0	-123.50	423	355.8	9.4	27.728	318.7	366.4	376.4	1.795
50.000	1026.173	.272	647.8	-123.72	423	356.1	9.3	28.118	318.8	367.2	377.2	1.796
3.278	20.414	14.696	1810.5	-10.07	497	283.1	32.7	2.223	283.1	292.9	311.9	1.391

SHIFTING EXPANSION
C STAR = 8751.8 FT/SEC

EPSILON	PC/P	P PSIA	TEMP DEG K	ENTHALPY KCAL/100GM	CP CAL/ I UPT DEG K	DELTA VAC DELTA VAC /P	I SEA LVL	I AT 10000	I AT 50000	I VAC	CF SEA LVL	CF VAC
1.000	1.000	300.000	3559.2	22.04	547	140.8	119.0	250.5	252.6	258.6	259.8	1.189
2.000	1.763	170.130	3261.1	-7.74	1.286	140.8	119.0	270.0	249.5	250.6	249.7	1.365
3.000	6.028	34.771	2700.7	-53.48	.805	257.3	50.6	1.454	284.5	292.9	305.4	1.365
4.000	15.187	19.754	2438.7	-71.22	.600	284.9	41.6	2.108	295.5	304.9	322.9	1.408
5.000	23.136	12.967	2252.1	-82.38	.462	301.4	36.3	2.799	309.0	319.4	337.7	1.456
6.000	32.171	9.321	2109.4	-90.33	.349	312.7	32.7	3.509	319.4	329.4	345.4	1.496
7.000	42.002	7.142	1995.6	-96.38	.272	321.0	30.1	4.220	329.4	339.4	351.1	1.473
8.000	52.259	5.741	1901.9	-101.21	.213	327.5	28.2	4.905	339.4	349.4	356.6	1.495
9.000	63.531	4.722	1823.5	-105.19	.167	332.7	26.6	5.625	349.4	359.4	362.3	1.512
10.000	75.574	3.970	1766.2	-108.55	.135	337.1	25.2	6.359	359.4	369.4	365.2	1.527
11.000	87.985	3.410	1697.5	-111.45	.110	340.0	24.1	7.078	369.4	379.4	368.0	1.539
12.000	100.582	2.983	1645.6	-113.97	.088	344.0	23.2	7.772	379.4	389.4	370.8	1.550
13.000	113.236	2.649	1599.3	-116.20	.070	348.3	22.3	8.436	389.4	399.4	373.6	1.559
14.000	126.364	2.374	1557.7	-118.20	.055	353.3	21.6	9.105	399.4	409.4	376.4	1.567
15.000	140.875	2.130	1520.1	-120.00	.047	358.3	21.0	9.841	409.4	419.4	379.4	1.575
16.000	155.746	1.926	1485.8	-121.63	.040	363.3	20.4	10.576	419.4	429.4	382.4	1.582
17.000	171.043	1.754	1454.2	-123.13	.034	368.3	19.8	11.305	429.4	439.4	385.4	1.588
18.000	186.538	1.608	1425.0	-124.50	.030	373.3	19.3	12.025	439.4	449.4	388.4	1.594
19.000	202.210	1.484	1398.0	-125.77	.026	378.3	18.9	12.733	449.4	459.4	391.4	1.599
20.000	217.960	1.374	1372.8	-126.95	.023	383.3	18.5	13.427	459.4	469.4	394.4	1.604
21.000	233.852	1.283	1349.2	-128.04	.020	388.3	18.1	14.105	469.4	479.4	397.4	1.608
22.000	249.739	1.201	1327.1	-129.07	.018	393.3	17.7	14.767	479.4	489.4	400.0	1.612
23.000	265.639	1.129	1306.3	-130.03	.016	398.3	17.4	15.413	489.4	499.4	403.4	1.616
24.000	282.715	1.061	1286.7	-130.93	.015	403.3	17.1	16.110	499.4	509.4	406.4	1.620
25.000	299.779	.997	1268.1	-131.78	.014	408.3	16.8	16.844	509.4	519.4	409.4	1.623
26.000	316.157	.940	1250.5	-132.59	.013	413.3	16.5	17.579	519.4	529.4	412.4	1.626
27.000	332.617	.888	1233.8	-133.35	.012	418.3	16.3	18.312	529.4	539.4	415.4	1.629
28.000	349.128	.841	1217.9	-134.08	.011	423.3	16.0	19.041	539.4	549.4	418.4	1.632
29.000	365.658	.798	1202.7	-134.76	.010	428.3	15.8	19.770	549.4	559.4	421.4	1.635
30.000	382.178	.759	1188.2	-135.42	.010	433.3	15.6	20.493	559.4	569.4	424.4	1.638
31.000	398.658	.723	1174.3	-136.05	.009	438.3	15.3	21.210	569.4	579.4	427.4	1.640
32.000	415.173	.691	1161.0	-136.65	.009	443.3	15.1	21.928	579.4	589.4	430.4	1.643
33.000	431.658	.661	1148.3	-137.22	.008	448.3	14.9	22.624	589.4	599.4	433.4	1.645
34.000	448.112	.633	1136.0	-137.77	.008	453.3	14.8	23.319	599.4	609.4	436.4	1.647
35.000	464.546	.608	1124.2	-138.30	.007	458.3	14.6	24.007	609.4	619.4	439.4	1.649
36.000	480.953	.584	1112.9	-138.81	.007	463.3	14.4	24.686				
37.000	497.412	.562	1102.0	-139.29	.006	468.3	14.3	25.356				
38.000	513.832	.542	1091.5	-139.76	.006	473.3	14.1	26.018				
39.000	530.248	.523	1081.2	-140.20	.005	478.3	13.9	26.671				
40.000	546.652	.505	1071.4	-140.65	.005	483.3	13.8	27.315				
41.000	563.045	.488	1061.9	-141.08	.005	488.3	13.7	27.955				
42.000	579.412	.471	1052.6	-141.48	.004	493.3	13.5	28.588				
43.000	595.758	.455	1043.3	-141.85	.004	498.3	13.4	29.215				
44.000	612.085	.439	1035.0	-142.24	.004	503.3	13.3	30.194				
45.000	628.395	.425	1026.6	-142.63	.004	508.3	13.1	30.928				
46.000	644.688	.411	1018.4	-142.99	.004	513.3	13.0	31.661				
47.000	660.965	.400	1010.1	-143.32	.003	518.3	12.9	32.392				
48.000	677.230	.388	1002.7	-143.68	.003	523.3	12.8	33.123				
49.000	693.484	.375	995.2	-144.01	.003	528.3	12.7	33.851				
50.000	709.725	.364	987.9	-144.33	.003	533.3	12.6	34.578				
51.000	725.954	.354	980.5	-144.63	.002	538.3	12.6	35.304				
52.000	742.171	.344	973.0	-144.90	.002	543.3	12.5	36.028				
53.000	758.375	.334	965.5	-145.15	.002	548.3	12.5	36.751				
54.000	774.566	.324	958.0	-145.38	.002	553.3	12.4	37.471				
55.000	790.744	.314	950.5	-145.59	.002	558.3	12.4	38.188				
56.000	806.909	.304	943.0	-145.78	.002	563.3	12.3	38.902				
57.000	823.061	.294	935.5	-145.95	.002	568.3	12.3	39.613				
58.000	839.199	.284	928.0	-146.10	.002	573.3	12.2	40.321				
59.000	855.324	.274	920.5	-146.23	.002	578.3	12.2	41.026				
60.000	871.436	.264	913.0	-146.34	.002	583.3	12.1	41.728				
61.000	887.535	.254	905.5	-146.44	.002	588.3	12.1	42.427				
62.000	903.621	.244	898.0	-146.52	.002	593.3	12.0	43.123				
63.000	919.694	.234	890.5	-146.59	.002	598.3	12.0	43.816				
64.000	935.754	.224	883.0	-146.64	.002	603.3	11.9	44.506				
65.000	951.801	.214	875.5	-146.68	.002	608.3	11.9	45.193				
66.000	967.835	.204	868.0	-146.70	.002	613.3	11.8	45.877				
67.000	983.856	.194	860.5	-146.71	.002	618.3	11.8	46.558				
68.000	1000.000	.184	853.0	-146.70	.002	623.3	11.7	47.236				
69.000	1016.000	.174	845.5	-146.68	.002	628.3	11.7	47.911				
70.000	1032.000	.164	838.0	-146.64	.002	633.3	11.6	48.583				
71.000	1048.000	.154	830.5	-146.59	.002	638.3	11.6	49.252				
72.000	1064.000	.144	823.0	-146.52	.002	643.3	11.5	49.918				
73.000	1080.000	.134	815.5	-146.44	.002	648.3	11.5	50.581				
74.000	1096.000	.124	808.0	-146.34	.002	653.3	11.4	51.241				
75.000	1112.000	.114	800.5	-146.23	.002	658.3	11.4	51.898				
76.000	1128.000	.104	793.0	-146.10	.002	663.3	11.3	52.551				
77.000	1144.000	.094	785.5	-145.95	.002	668.3	11.3	53.201				
78.000	1160.000	.084	778.0	-145.78	.002	673.3	11.2	53.848				
79.000	1176.000	.074	770.5	-145.59	.002	678.3	11.2	54.491				
80.000	1192.000	.064	763.0	-145.38	.002	683.3	11.1	55.131				
81.000	1208.000	.054	755.5	-145.15	.002	688.3	11.1	55.768				
82.000	1224.000	.044	748.0	-144.90	.002	693.3	11.0	56.401				
83.000	1240.000	.034	740.5	-144.63	.002	698.3	11.0	57.031				
84.000	1256.000	.024	733.0	-144.33	.002	703.3	10.9	57.658				
85.000	1272.000	.014	725.5	-144.01	.002	708.3	10.9	58.281				
86.000	1288.000	.004	718.0	-143.68	.002	713.3	10.8	58.901				
87.000	1304.000	.000	710.5	-143.32	.002	718.3	10.8	59.518				
88.000	1320.000	.000	703.0	-142.99	.002	723.3	10.7	60.131				
89.000	1336.000	.000	695.5	-142.63	.002	728.3	10.7	60.741				
90.000	1352.000	.000	688.0	-142.24	.002	733.3	10.6	61.348				
91.000	1368.000	.000	680.5	-141.85	.002	738.3	10.6	61.951				
92.000	1384.000	.000	673.0	-141.48	.002	743.3	10.5	62.551				
93.000	1400.000	.000	665.5	-141.08	.002	748.3	10.5	63.148				
94.000	1416.000	.000	658.0	-140.65	.002	753.3	10.4	63.741				
95.000	1432.000	.000	650.5	-140.20	.002	758.3	10.4	64.331				
96.000	1448.000	.000	643.0	-139.76	.002	763.3	10.3	64.918				
97.000	1464.000	.000	635.5	-139.29	.002	768.3	10.3	65.501				
98.000	1480.000	.000	628.0	-138.81	.002	773.3	10.2	66.081				
99.000	1496.000	.000	620.5	-138.30	.002	778.3	10.2	66.658				
100.000	1512.000	.000	613.0	-137.77	.002	783.3	10.1	67.231				
101.000	1528.000	.000	605.5	-137.22	.002	788.3	10.1	67.801				
102.000	1544.000	.000	598.0	-136.65	.002	793.3	10.0	68.368				
103.000	1560.000	.000	590.5	-136.05	.002	798.3						

PRESSURE PROFILE DATA					
SYSTEM LIQUID		BIPROPELLANT		PC 300	PSIA
COMPONENT	TREF	FORMULA	DENSITY	HEAT FORM	WT. 0/0
	DEG K		GM/CC	(KCAL/FORM.WT.)	
128	0°F2		1.53	+3.5	56.
298	N2+H4		1.004	+12.05	44.

BULK DENSITY = 1.243 GM/CC
MIXTURE RATIO = 1.273 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA													
CHAMBER ENTROPY 323.41 EU/100GMS													
CHAMBER													THROAT
FROZEN EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	165.0
TEMP, DEG K	3739.5	3137.9	2623.5	2184.1	1890.7	1808.6	1488.2	1215.6	985.5	793.5	635.3	506.7	3281.4
ENTHALPY (-)	-20.17	10.47	36.14	57.56	71.51	75.35	90.03	102.08	111.88	119.79	126.15	131.23	3.21
CP	.5140	.5044	.4934	.4809	.4696	.4660	.4498	.4332	.4184	.4064	.3979	.3924	.5069
IMPUL OPT	163.27	221.34	260.05	282.41	288.27	309.64	326.11	338.93	348.95	356.79	362.92	362.92	142.63
IMPUL VAC	256.55	278.87	300.81	314.90	318.72	332.98	344.70	353.04	359.98	365.43	369.70	369.70	254.29
EPSILON	1.023	1.405	2.217	3.267	3.689	6.293	10.869	18.842	32.881	57.337	100.117	1.000	
SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	171.0
TEMP, DEG K	3739.5	3434.1	3150.6	2873.6	2653.3	2583.5	2264.8	1932.0	1620.1	1345.6	1108.8	906.8	3522.4
ENTHALPY (-)	-20.17	11.48	39.91	65.42	83.15	88.20	108.23	125.47	140.02	152.16	162.20	170.45	2.37
X BAR	5.614	5.486	5.373	5.279	5.223	5.210	5.172	5.158	5.156	5.156	5.156	5.156	5.523
N	5.614	5.486	5.373	5.279	5.223	5.210	5.172	5.158	5.156	5.156	5.156	5.156	5.523
CP	1.7301	1.5930	1.3767	1.0900	.8581	.7941	.5844	.4881	.4524	.4327	.4157	.4007	1.6413
IMPUL OPT	165.93	228.62	272.88	299.81	307.06	334.22	355.96	373.31	387.19	398.32	407.22	407.22	140.05
IMPUL VAC	264.09	292.63	320.94	339.77	344.95	364.52	380.16	392.65	402.68	410.72	417.15	417.15	260.14
EPSILON	1.038	1.507	2.520	3.873	4.425	7.678	14.016	24.947	44.487	79.356	141.364	1.000	
COMPOSITION SHIFTING (MOL/100 GM)													
18.86 F	.0245	.0131	.0063	.0025	.0010	.0007	.0001	.0000	.0000	.0000	.0000	.0000	.0159
-64.50 F+H	2.0495	2.0610	2.0678	2.0716	2.0731	2.0734	2.0740	2.0741	2.0741	2.0741	2.0741	2.0741	2.0581
-26.10 F+H+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
58.60 F+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-15.70 F+H+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.4403	.3286	.2301	.1440	.0875	.0725	.0243	.0046	.0005	.0000	.0000	.0000	.3406
79.20 H+N	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-10.00 H+N+O	.0032	.0021	.0013	.0007	.0003	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0024
9.33 H+O	.2136	.1640	.1127	.0644	.0337	.0262	.0060	.0006	.0000	.0000	.0000	.0000	.1792
.00 H2	.7383	.7080	.6799	.6604	.6555	.6559	.6635	.6699	.6716	.6718	.6718	.6718	.7170
40.30 H2+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2+O	.6542	.7600	.8601	.9452	.9931	1.0038	1.0302	1.0364	1.0370	1.0370	1.0370	1.0370	.7286
-11.04 H3+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
21.65 N+O	.0450	.0302	.0178	.0085	.0037	.0027	.0004	.0000	.0000	.0000	.0000	.0000	.0344
8.06 N+O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	1.3485	1.3566	1.3633	1.3684	1.3709	1.3715	1.3727	1.3729	1.3729	1.3729	1.3729	1.3729	1.3543
19.50 N2+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.0713	.0436	.0224	.0085	.0028	.0018	.0001	.0000	.0000	.0000	.0000	.0000	.0512
.00 O2	.0249	.0186	.0114	.0049	.0017	.0012	.0001	.0000	.0000	.0000	.0000	.0000	.0206

SYSTEM LIQUID BIPROPELLANT PC 300 PSIA

COMPONENT	TREF FORMULA	DENSITY	HEAT FORM	WT. G/G
DEG K		GM/CC	(KCAL/FORM.WT.)	
128	80F2	1.53	+3.5	62.
298	N20H4	1.004	+12.05	38.

BULK DENSITY = 1.276 GM/CC
MIXTURE RATIO = 1.632 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 310.73 EU/100GMS

CHAMBER													THROAT	
FROZEN EXPANSION														
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	164.1	
TEMP, DEG K	3868.0	3234.4	2695.1	2236.4	1931.2	1846.0	1514.3	1233.3	997.1	800.5	639.3	508.7	3381.1	
ENTHALPY (-)	-18.31	11.81	36.96	57.87	71.45	73.19	89.43	101.98	110.52	118.15	124.25	129.11	4.89	
CP	.4794	.4711	.4611	.4497	.4399	.4366	.4221	.4067	.3932	.3822	.3746	.3698	.4730	
IMPUL OPT		161.87	219.27	257.44	279.43	285.19	306.15	322.27	334.79	344.54	352.16	358.11	142.06	
IMPUL VAC		254.19	276.06	297.57	311.36	315.09	329.00	339.95	348.55	355.27	360.54	364.67	252.02	
EPSILON		1.022	1.401	2.205	3.242	3.658	6.225	10.726	18.589	32.296	56.191	97.911	1.000	

	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	171.3
TEMP, DEG K	3868.0	3562.2	3287.8	3036.2	2853.2	2798.8	2565.8	2324.3	2094.4	1750.6	1464.4	1214.5	3650.4
ENTHALPY (-)	-18.31	12.87	40.94	66.29	84.07	89.20	109.92	128.52	145.03	159.29	171.30	181.31	3.85
X BAR	5.344	5.214	5.095	4.987	4.913	4.892	4.812	4.751	4.715	4.706	4.705	4.705	5.252
N	5.344	5.214	5.095	4.987	4.913	4.892	4.812	4.751	4.715	4.706	4.705	4.705	5.252
CP	1.7920	1.7408	1.6834	1.6420	1.6117	1.5912	1.5507	.7920	.5477	.4347	.4089	.3919	1.7610
IMPUL OPT	164.69	227.02	271.28	298.44	305.82	333.98	357.39	376.95	393.06	406.14	416.72	428.83	138.83
IMPUL VAC	262.19	290.81	319.53	339.05	344.53	365.95	384.11	399.17	411.18	420.81	428.57	438.22	258.22
EPSILON	1.039	1.513	2.550	3.966	4.554	8.375	15.588	28.870	52.437	94.523	170.151	1.000	

COMPOSITION SHIFTING (MOL/100 GM)													
18.86 F	.0517	.0305	.0174	.0093	.0054	.0045	.0019	.0006	.0001	.0000	.0000	.0000	.0359
-64.50 F+H	2.2446	2.2657	2.2789	2.2870	2.2909	2.2918	2.2944	2.2957	2.2962	2.2963	2.2963	2.2963	2.2604
-26.10 F+H+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
58.60 F+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-15.70 F+N+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.4118	.3116	.2251	.1522	.1058	.0934	.0491	.0199	.0053	.0008	.0001	.0000	.3403
79.20 H+N	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-10.00 H+N+O	.0037	.0027	.0019	.0013	.0009	.0008	.0005	.0002	.0001	.0000	.0000	.0000	.0030
9.33 H+O	.2815	.2432	.2000	.1544	.1195	.1091	.0669	.0317	.0083	.0007	.0000	.0000	.2553
.00 H2	.4140	.3747	.3294	.2791	.2378	.2249	.1693	.1176	.0826	.0753	.0751	.0751	.3871
40.30 H2+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2+O	.4865	.5851	.6890	.7949	.8751	.8990	.9967	1.0801	1.1339	1.1473	1.1481	1.1481	.5548
-11.04 H3+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0006	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
21.45 N+O	.0775	.0609	.0459	.0326	.0238	.0214	.0123	.0053	.0012	.0001	.0000	.0000	.0657
8.06 N+O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	1.1447	1.1537	1.1618	1.1687	1.1733	1.1744	1.1794	1.1829	1.1851	1.1857	1.1857	1.1857	1.1511
19.50 N2+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.1555	.1147	.0792	.0500	.0322	.0277	.0122	.0035	.0004	.0000	.0000	.0000	.1244
.00 O2	.0717	.0708	.0661	.0574	.0483	.0451	.0298	.0137	.0022	.0000	.0000	.0000	.0714

PRESSURE PROFILE DATA				
SYSTEM LIQUID BIPROPELLANT PC 300 PSIA				
COMPONENT	TREF FORMULA	DENSITY	HEAT FORM	WT. O/O
	DEG K	GM/CC	(KCAL/FORM.WT.)	
128 O ₂ F ₂		1.53	+3.5	70.
298 N ₂ H ₄		1.004	+12.05	30.

BULK DENSITY = 1.322 GM/CC
MIXTURE RATIO = 2.333 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
CHAMBER ENTROPY 292.28 EU/100GMS

CHAMBER	THROAT												
FROZEN EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	163.4
TEMP, DEG K	3987.9	3313.0	2742.6	2260.7	1942.3	1853.8	1510.8	1222.6	982.5	784.5	623.5	493.9	3465.6
ENTHALPY (-)	-15.82	13.19	57.25	57.13	69.96	73.48	86.84	97.70	106.45	113.47	119.05	123.49	6.68
CP	.4333	.4257	.4172	.4072	.3987	.3958	.3832	.3701	.3588	.3500	.3441	.3407	.4277
IMPUL OPT	158.85	214.86	251.90	273.16	278.71	298.84	314.24	326.14	335.36	342.53	348.12	349.89	
IMPUL VAC	249.14	270.12	290.76	303.95	307.51	320.73	331.09	339.18	345.49	350.41	354.26	247.14	
EPSILON	1.021	1.392	2.179	3.192	3.597	6.089	10.435	17.994	31.115	53.916	93.595	1.000	
SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	171.6
TEMP, DEG K	3987.9	3663.6	3369.2	3096.2	2894.9	2834.3	2570.2	2287.6	1979.1	1668.0	1384.4	1138.0	3758.0
ENTHALPY (-)	-15.82	14.28	41.31	65.63	82.63	87.52	107.16	124.61	139.83	152.78	163.60	172.54	5.53
X BAR	5.008	4.889	4.780	4.683	4.618	4.600	4.534	4.491	4.471	4.466	4.465	4.465	4.923
N	5.008	4.889	4.780	4.683	4.618	4.600	4.534	4.491	4.471	4.466	4.465	4.465	4.923
CP	1.5991	1.5168	1.4001	1.2378	1.0831	1.0321	.8006	.5893	.4533	.3951	.3707	.3553	1.5458
IMPUL OPT	161.82	222.92	266.19	292.65	299.85	327.08	349.51	367.97	382.97	395.07	404.79	136.29	
IMPUL VAC	257.50	285.38	313.28	332.14	337.42	357.89	374.92	388.75	399.79	408.60	415.64	253.65	
EPSILON	1.038	1.509	2.534	3.928	4.505	8.221	15.102	27.514	49.561	88.779	158.614	1.000	
COMPOSITION SHIFTING (MOL/100 GM)													
18.86 F	.1322	.0815	.0477	.0261	.0155	.0130	.0055	.0017	.0003	.0000	.0000	.0000	.0948
-64.50 F=H	2.4604	2.5111	2.5449	2.5664	2.5771	2.5796	2.5871	2.5909	2.5923	2.5926	2.5926	2.5926	2.4977
-26.10 F=H=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
58.60 F=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-15.70 F=N=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.2890	.2116	.1450	.0899	.0562	.0475	.0189	.0045	.0005	.0000	.0000	.0000	.2339
79.20 H=N	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-10.00 H=N=O	.0030	.0023	.0017	.0012	.0009	.0008	.0005	.0003	.0001	.0000	.0000	.0000	.0025
9.33 H=O	.2736	.2479	.2151	.1759	.1423	.1318	.0855	.0431	.0143	.0028	.0003	.0000	.2564
.00 H2	.1411	.1197	.0970	.0726	.0539	.0483	.0258	.0094	.0018	.0002	.0000	.0000	.1263
40.30 H2=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2=O	.2180	.2661	.3219	.3826	.4300	.4441	.5003	.5434	.5668	.5743	.5757	.5759	.2506
-11.04 H3=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0008	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004
21.65 N=O	.1188	.1012	.0837	.0667	.0543	.0506	.0355	.0218	.0106	.0038	.0010	.0002	.1066
8.06 N=O2	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
.00 N2	.8747	.8841	.8933	.9021	.9085	.9103	.9181	.9251	.9307	.9342	.9356	.9360	.8813
19.50 N2=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.3091	.2466	.1851	.1282	.0895	.0788	.0396	.0138	.0026	.0002	.0000	.0000	.2655
.00 O2	.1868	.2161	.2444	.2708	.2896	.2951	.3174	.3370	.3509	.3575	.3596	.3601	.2073

SYSTEM LIQUID BI-PROPELLANT PC 300 PSIA													
COMPONENT		THERM FORMULA		DENSITY		HEAT FORM		HT. S/R					
		DEG K		GM/CC		(KCAL/POUND.WT.)		TO					
		1218 8052		1.004		+12.05		30.					
		298 H2+H2											
FARZEN EXPANSION													
C STAR = 6334.0 FT/SEC													
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DELYAC	DELYAC	I SEA	I AT	I AT	I VAC	CF SEA CF VAC
			DEG K	KCAL/100GM	GM DEG		/P	/P	LVL	10000	50000	LVL	LVL
1.000	1.000	100.000	1987.9	15.82	1.592								
1.000	1.036	103.428	2405.4	-0.68	.428	139.9	107.3	.656	237.5	240.4	246.0	247.1	1.206 1.255
2.000	10.053	29.841	2334.9	-54.12	.409	297.1	49.5	1.351	281.2	273.2	285.1	287.4	1.359 1.440
3.000	18.571	16.156	1989.9	-66.06	.400	270.1	31.9	1.973	273.0	261.7	290.6	302.0	1.387 1.534
4.000	29.041	10.330	1778.4	-76.44	.393	283.1	27.2	2.431	283.5	268.0	306.0	310.5	1.577 1.606
5.000	40.983	7.320	1630.9	-87.21	.388	292.0	24.2	3.101					1.606
6.000	53.625	5.549	1519.4	-96.51	.386	298.4	22.0	3.921					1.627
7.000	68.024	4.610	1430.4	-104.90	.380	303.3	20.4	4.829					1.644
8.000	83.546	3.899	1357.4	-112.44	.374	307.2	19.1	5.816					1.657
9.000	99.135	3.026	1296.2	-119.46	.374	310.4	18.1	6.971					1.669
10.000	115.045	2.608	1243.4	-126.93	.371	313.2	17.2	8.391					1.678
11.000	132.213	2.269	1197.3	-134.63	.369	315.5	16.4	9.939					1.685
12.000	150.758	1.987	1156.5	-142.18	.367	317.6	15.8	11.551					1.693
13.000	170.532	1.761	1120.1	-149.47	.365	319.4	15.2	13.317					1.700
14.000	190.181	1.577	1087.5	-156.47	.364	321.1	14.7	15.242					1.705
15.000	210.352	1.426	1057.5	-163.15	.362	322.5	14.2	17.329					1.710
16.000	230.723	1.300	1030.3	-169.70	.361	323.8	13.8	19.582					1.715
17.000	251.209	1.196	1005.4	-176.05	.360	325.0	13.4	22.012					1.719
18.000	271.775	1.109	982.3	-182.14	.359	326.1	13.0	24.613					1.723
19.000	296.476	1.017	961.0	-187.92	.358	327.2	12.7	27.383					1.726
20.000	316.472	.941	941.1	-193.43	.357	328.1	12.4	30.413					1.730
21.000	341.102	.861	922.5	-198.60	.356	329.0	12.1	33.602					1.735
22.000	367.883	.815	905.1	-203.22	.355	329.8	11.9	36.967					1.735
23.000	393.052	.763	888.7	-207.60	.355	330.6	11.6	40.527					1.738
24.000	418.543	.717	873.3	-211.34	.354	331.3	11.4	44.280					1.742
25.000	444.297	.676	858.8	-214.88	.353	332.0	11.2	48.226					1.745
26.000	470.260	.638	845.0	-218.34	.353	332.6	11.0	52.369					1.748
27.000	496.384	.604	832.0	-221.60	.352	333.2	10.8	56.704					1.751
28.000	522.632	.574	819.5	-224.74	.351	333.8	10.6	61.237					1.754
29.000	549.077	.546	807.7	-227.65	.351	334.3	10.5	65.964					1.751
30.000	575.666	.521	796.5	-230.35	.350	334.8	10.3	70.881					1.753
31.000	601.861	.498	785.7	-232.82	.350	335.3	10.1	75.992					1.755
32.000	627.047	.475	775.4	-235.05	.350	335.8	10.0	81.300					1.756
33.000	651.618	.454	765.6	-237.05	.349	336.2	9.9	86.810					1.758
34.000	674.927	.434	756.1	-238.84	.349	336.6	9.7	92.519					1.759
35.000	697.233	.415	747.1	-240.47	.348	337.1	9.6	98.429					1.761
36.000	718.917	.398	738.3	-241.90	.348	337.4	9.5	104.547					1.762
37.000	739.947	.382	730.0	-243.15	.348	337.8	9.4	110.874					1.763
38.000	760.467	.367	721.9	-244.25	.348	338.2	9.2	117.419					1.765
39.000	780.927	.353	714.1	-245.12	.347	338.5	9.1	124.180					1.766
40.000	801.320	.340	706.6	-245.80	.347	338.9	9.0	131.156					1.767
41.000	821.946	.328	699.3	-246.33	.347	339.2	8.9	138.346					1.768
42.000	842.780	.317	692.3	-246.75	.346	339.5	8.8	145.750					1.769
43.000	863.197	.306	685.5	-247.05	.346	339.8	8.7	153.369					1.770
44.000	883.975	.296	679.0	-247.14	.346	340.1	8.6	161.201					1.771
45.000	904.293	.287	672.4	-247.16	.346	340.4	8.6	169.234					1.772
46.000	924.732	.278	666.4	-247.57	.346	340.6	8.5	177.468					1.773
47.000	945.117	.269	660.5	-247.70	.345	340.9	8.4	185.903					1.774
48.000	965.906	.262	654.7	-247.78	.345	341.2	8.3	194.537					1.775
49.000	986.613	.254	649.0	-247.77	.345	341.4	8.2	203.385					1.776
50.000	1007.385	.247	643.5	-247.60	.345	341.7	8.2	212.447					1.777
3.192	20.416	16.696	1962.3	-69.96	.399	275.2	50.8	2.095	275.2	282.4	300.4	303.9	1.487 1.544

SHIFTING EXPANSION													
C STAR = 6035.2 FT/SEC													
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DELYAC	DELYAC	I SEA	I AT	I AT	I VAC	CF SEA CF VAC
			DEG K	KCAL/100GM	GM DEG		/P	/P	LVL	10000	50000	LVL	LVL
1.000	1.000	100.000	1987.9	15.82	1.592								
1.000	1.749	171.534	1756.5	-5.51	1.346	156.4	117.4	.688	245.6	246.0	252.5	253.7	1.236 1.187
2.000	8.517	16.069	5204.6	-55.76	1.313	250.2	51.4	1.426	280.7	287.0	299.3	301.7	1.368 1.470
3.000	16.137	21.220	5016.6	-72.48	1.180	277.2	43.8	2.063	290.6	299.0	317.4	321.0	1.416 1.564
4.000	20.931	16.333	2886.8	-65.29	1.076	293.6	39.2	2.737	304.7	320.2	332.9	337.1	1.622 1.603
5.000	26.359	10.579	2786.4	-61.13	.992	305.0	36.2	3.427	306.1	326.2	341.3	347.7	1.694 1.694
6.000	36.324	6.252	2708.8	-67.22	.922	313.6	33.1	4.127					
7.000	44.572	6.731	2641.3	-102.18	.862	320.4	32.4	4.816					
8.000	52.926	5.668	2582.5	-106.33	.811	326.0	31.1	5.481					
9.000	61.497	4.839	2527.5	-109.00	.766	330.7	29.9	6.184					
10.000	71.542	4.183	2481.6	-115.03	.728	334.8	28.9	6.928					
11.000	81.300	3.690	2437.8	-115.79	.693	338.4	28.1	7.611					
12.000	91.179	3.290	2397.2	-118.27	.663	341.5	27.3	8.305					
13.000	101.110	2.967	2359.5	-120.51	.636	344.4	26.6	8.980					
14.000	111.044	2.702	2324.2	-122.55	.615	346.9	26.0	9.655					
15.000	120.961	2.480	2290.9	-124.42	.591	349.3	25.5	10.328					
16.000	131.981	2.273	2258.9	-126.16	.573	351.4	24.9	10.971					
17.000	143.374	2.092	2228.4	-127.77	.557	353.4	24.4	11.604					
18.000	156.493	1.936	2199.4	-129.27	.542	355.3	24.0	12.226					
19.000	169.805	1.799	2171.8	-130.67	.528	357.0	23.6	12.836					
20.000	178.781	1.678	2145.5	-131.99	.516	358.6	23.2	13.436					
21.000	190.890	1.572	2120.3	-133.22	.505	360.1	22.8	14.023					
22.000	205.107	1.477	2096.2	-134.39	.495	361.5	22.4	14.592					
23.000	215.412	1.393	2073.5	-135.49	.486	362.8	22.1	15.142					
24.000	227.784	1.317	2050.8	-136.53	.478	364.1	21.8	15.682					
25.000	240.211	1.249	2029.5	-137.53	.470	365.2	21.5	16.203					
26.000	252.682	1.187	2008.9	-138.48	.463	366.4	21.2	16.705					
27.000	265.192	1.131	1989.0	-139.38	.456	367.4	20.9	17.197					
28.000	278.515	1.078	1969.7	-140.24	.451	368.5	20.7	17.680					
29.000	292.209	1.027	1951.1	-141.06	.446	369.4	20.4	18.159					
30.000	306.299	.979	1933.0	-141.85	.441	370.4	20.2	18.631					
31.000	320.571	.936	1915.6	-142.61	.437	371.2	19.9	19.097					
32.000	335.012	.895	1898.7	-143.34	.433	372.1	19.7	19.557					
33.000	349.611	.858	1882.3	-144.04	.429	372.9	19.5	20.012					
34.000	364.355	.823	1866.4	-144.71	.426	373.7	19.3	20.462					
35.000	379.230	.791	1851.0	-145.36	.423	374.5	19.1	20.913					
36.000	394.227	.761	1835.8	-145.99	.420	375.2	18.9	21.363					
37.000	409.334	.733	1820.4	-146.60	.417	376.0	18.7	21.813					
38.000	424.540	.707	1805.2	-147.18	.415	376.8	18.5	22.263					
39.000	439.835	.682	1790.5	-147.75	.412	377.2	18.4	22.693					
40.000	455.210	.659	1786.1	-148.29	.410	377.8	18.2	23.107					
41.000	470.656	.637	1781.6	-148.80	.408	378.3	18.0	23.516					
42.000	486.166	.617	1775.4	-149.38	.406	378.9	17.9	23.940					
43.000	501.732	.598	1769.6	-149.88	.405	379.0	17.9	24.331					
44.000	517.350	.580	1763.0	-150.32	.403	380.2	17.8	24.797					
45.000	533.012	.563	1757.2	-150.75	.401	380.7	17.8	25.304					
46.000	548.715	.547	1750.7	-151.25	.400	381.2	17.7	25.814					
47.000	564.456	.531	1695.5	-151.69	.398	381.7	17.7	32.244					
48.000	580.232	.517	1688.6	-152.13	.397	382.2	17.7	32.709					
49.000	596.041	.503	1681.7	-152.55	.396	382.7	17.6	33.549					
50.000	611.884	.490	1675.0	-152.96	.395	383.2	17.6	34.393					
51.228	70.416	1.076	2689.7	-82.63	1.083	232.4	38.5	2.817	292.6	308.5	327.4	336.1	1.424 1.616

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Ford Motor Company
AERONUTRONIC DIVISION

$O_2 - H_2$ SYSTEM

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 O2 1.14 -3.08 68.
 LM2 20.4 H2 0.071 -1.887 32.

BULK DENSITY = .196 GM/CC
 MIXTURE RATIO = 2.125 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 671.05 EU/100GMS

	CHAMBER											THROAT													
	FROZEN EXPANSION																								
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	545.1												
TEMP, DEG K	1919.3	1565.0	1262.4	1007.3	796.3	692.1	625.1	488.3	380.5	295.3	225.5	166.2	1679.6												
ENTHALPY (-)	36.50	86.97	127.93	160.79	186.89	199.46	207.45	223.55	236.09	245.88	253.82	260.49	70.91												
CP	1.4574	1.3901	1.3173	1.2597	1.2161	1.1969	1.1866	1.1697	1.1554	1.1427	1.1313	1.1211	1.4124												
IMPUL OPT		209.55	282.04	328.84	361.71	376.53	385.65	403.40	416.71	426.80	434.82	441.44	173.03												
IMPUL VAC		312.04	343.46	370.87	391.92	401.75	407.89	420.02	429.24	436.30	441.93	446.61	306.24												
EPSILON		1.053	1.586	2.726	4.922	7.024	9.102	17.075	32.352	61.577	115.926	211.473	1.000												
	SHIFTING EXPANSION																								
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	545.5												
TEMP, DEG K	1919.3	1565.5	1262.9	1007.7	796.7	692.4	625.3	488.6	380.7	295.4	225.6	166.3	1680.4												
ENTHALPY (-)	36.50	86.98	127.95	160.82	186.93	199.51	207.50	223.61	236.15	245.95	253.89	260.56	70.87												
K BAR	15.874	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873												
N	15.874	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873												
CP	1.4638	1.3907	1.3174	1.2598	1.2163	1.1972	1.1865	1.1696	1.1553	1.1432	1.1310	1.1212	1.4141												
IMPUL OPT		209.57	282.07	328.88	361.76	376.58	385.70	403.46	416.77	426.87	434.89	441.51	172.92												
IMPUL VAC		312.08	343.51	370.92	391.98	401.81	407.95	420.08	429.30	436.37	442.00	446.68	306.27												
EPSILON		1.053	1.586	2.726	4.921	7.023	9.100	17.073	32.348	61.572	115.921	211.486	1.000												
	COMPOSITION SHIFTING (MOL/100 GM)																								
52.10 H	.0015	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003												
9.33 H2O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000												
.00 H2	11.6223	11.6230	11.6230	11.6230	11.6230	11.6230	11.6230	11.6230	11.6230	11.6230	11.6230	11.6230	11.6229												
-57.80 H2O	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500												
59.56 O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000												
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000												

SYSTEM LIQUID BIPROPELLANT PC 1000. #SIA
COMPONENT TREF FORMULA DENSITY HEAT FURN
DEG K CH/CC (KCAL/POUN.WT.)
LON 90.2 OZ 1.16 -3.08 68.
LW2 20.4 HZ 0.071 -1.887 32.

FABZEN EXPANSION																
C STAR = 7863.0 FT/SEC																
EPSILON	PC/P	P PSIA	TEMP DEG K	ENTHALPY KCAL/100GM	CP CAL/DEG K	OPT	DELVAC FT/SEC	DELVAC FT/SEC	I SEA LVL	I AT 10000	I AT 50000	I VAC	CF SEA LVL	CF VAC LVL		
1.000	1.833	545.084	1679.6	-70.91	1.412	173.0	133.2	.244	302.6	303.7	305.8	306.2	1.238	1.253		
2.000	10.352	96.601	1138.3	-144.18	1.289	306.9	49.9	.516	349.2	351.5	355.9	356.8	1.429	1.460		
3.000	18.685	53.518	969.0	-165.60	1.251	335.2	39.6	.740	363.9	367.2	373.5	374.8	1.489	1.534		
4.000	29.715	33.453	864.0	-178.63	1.230	351.7	33.6	.999	370.7	375.1	383.6	385.4	1.517	1.577		
5.000	40.811	24.503	791.4	-187.49	1.215	362.4	30.0	1.223	374.4	379.8	390.3	392.4	1.532	1.606		
6.000	53.931	18.542	736.4	-194.14	1.205	370.3	27.3	1.471	376.0	382.5	395.1	397.6	1.539	1.627		
7.000	67.713	14.768	693.0	-199.35	1.197	376.4	25.3	1.711	376.5	384.1	398.7	401.7	1.541	1.644		
8.000	82.725	12.088	657.6	-203.59	1.191	381.3	23.7	1.958								
9.000	98.385	10.164	627.8	-207.12	1.187	385.5	22.4	2.200								
10.000	115.796	8.673	602.4	-210.14	1.183	388.7	21.3	2.452								
11.000	133.173	7.509	583.2	-212.76	1.181	391.6	20.3	2.707								
12.000	151.771	6.589	560.7	-215.06	1.178	394.1	19.5	2.962								
13.000	170.904	5.891	543.4	-217.10	1.176	396.4	18.8	3.214								
14.000	190.400	5.252	527.8	-218.93	1.174	398.4	18.2	3.461								
15.000	210.106	4.740	513.7	-220.58	1.173	400.2	17.6	3.701								
16.000	229.901	4.350	500.9	-222.08	1.171	401.8	17.1	3.933								
17.000	249.701	4.005	489.2	-223.45	1.170	403.3	16.6	4.156								
18.000	272.290	3.673	478.4	-224.72	1.168	404.7	16.2	4.417								
19.000	295.726	3.382	468.3	-225.89	1.167	405.9	15.8	4.682								
20.000	319.720	3.128	459.1	-226.97	1.166	407.1	15.5	4.947								
21.000	344.184	2.905	450.4	-227.98	1.165	408.2	15.1	5.210								
22.000	369.030	2.710	442.3	-228.93	1.164	409.2	14.8	5.472								
23.000	394.171	2.537	434.7	-229.81	1.163	410.1	14.5	5.731								
24.000	419.522	2.384	427.5	-230.65	1.162	411.0	14.3	5.986								
25.000	445.006	2.247	420.7	-231.43	1.161	411.8	14.0	6.237								
26.000	470.550	2.125	414.4	-232.17	1.160	412.6	13.8	6.485								
27.000	496.093	2.016	408.3	-232.87	1.159	413.3	13.6	6.725								
28.000	521.578	1.917	402.5	-233.54	1.158	414.0	13.3	6.957								
29.000	546.963	1.828	397.1	-234.17	1.158	414.7	13.1	7.188								
30.000	572.213	1.748	391.9	-234.78	1.157	415.3	12.9	7.408								
31.000	597.306	1.675	386.9	-235.35	1.156	415.9	12.6	7.619								
32.000	622.210	1.607	382.1	-235.90	1.156	416.5	12.6	7.834								
33.000	646.910	1.538	377.6	-236.43	1.155	417.1	12.4	8.076								
34.000	680.040	1.471	373.2	-236.94	1.154	417.6	12.3	8.340								
35.000	710.400	1.408	369.0	-237.42	1.154	418.1	12.1	8.604								
36.000	741.145	1.349	365.0	-237.95	1.153	418.6	12.0	8.871								
37.000	772.342	1.295	361.2	-238.33	1.153	419.0	11.8	9.132								
38.000	803.849	1.244	357.3	-238.76	1.152	419.5	11.7	9.399								
39.000	835.677	1.197	353.7	-239.18	1.152	419.9	11.6	9.659								
40.000	867.766	1.152	350.3	-239.59	1.151	420.3	11.4	9.921								
41.000	900.177	1.111	346.9	-239.97	1.151	420.7	11.3	10.187								
42.000	932.791	1.072	343.6	-240.34	1.150	421.1	11.2	10.447								
43.000	965.610	1.036	340.5	-240.71	1.150	421.5	11.1	10.702								
44.000	998.655	1.001	337.4	-241.06	1.149	421.9	11.0	10.959								
45.000	1031.750	0.969	334.5	-241.40	1.149	422.2	10.9	11.213								
46.000	1065.018	0.939	331.6	-241.73	1.148	422.6	10.8	11.466								
47.000	1098.387	0.910	328.8	-242.05	1.148	422.9	10.7	11.721								
48.000	1131.831	0.884	326.1	-242.36	1.147	423.2	10.6	11.965								
49.000	1165.323	0.858	323.4	-242.66	1.147	423.5	10.5	12.215								
50.000	1198.861	0.834	320.9	-242.96	1.147	423.8	10.4	12.457								
7.024	68.046	14.696	692.1	-199.46	1.197	376.5	25.2	1.717	376.5	384.1	398.8	401.8	1.541	1.644		

SHIFTING EXPANSION																		
C STAR = 7865.9 FT/SEC																		
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	DEG K	KCAL/100GM	GR DEG	OPT	DELVAC	DELVAC	DELVAC	I SEA	I AT 10000	I AT 50000	I VAC	CF SEA	CF VAC
1.000	1.833	545.084	1680.4	-70.87	1.414	172.9	133.4	.244	302.7	303.8	305.9	306.3	1.253	1.233				
2.000	10.355	96.571	1138.6	-144.22	1.289	307.0	49.9	.516	349.2	351.5	355.9	356.8	1.428	1.459				
3.000	18.690	53.505	969.3	-165.64	1.252	335.3	39.6	.740	364.0	367.3	373.6	374.9	1.489	1.533				
4.000	29.722	33.446	864.3	-178.67	1.230	351.8	33.6	1.000	370.7	375.1	383.6	385.4	1.516	1.576				
5.000	40.811	24.503	791.6	-187.54	1.215	362.5	30.0	1.223	374.5	379.9	390.4	392.5	1.532	1.605				
6.000	53.942	18.539	736.7	-194.19	1.205	370.2	27.3	1.472	376.1	382.6	395.2	397.7	1.538	1.625				
7.000	67.725	14.768	693.3	-199.40	1.197	376.5	25.3	1.711	376.6	384.2	398.8	401.7	1.540	1.643				
8.000	82.741	12.088	657.8	-203.64	1.192	381.3	23.7	1.959										
9.000	98.401	10.164	627.9	-207.17	1.187	385.5	22.4	2.201										
10.000	115.818	8.672	602.6	-210.20	1.183	388.7	21.3	2.453										
11.000	133.198	7.508	580.4	-212.81	1.180	391.7	20.3	2.708										
12.000	151.798	6.588	560.9	-215.11	1.178	394.2	19.5	2.963										
13.000	170.935	5.890	543.6	-217.16	1.176	396.5	18.8	3.215										
14.000	190.433	5.251	528.0	-218.99	1.174	398.5	18.2	3.462										
15.000	210.141	4.759	514.0	-220.64	1.172	400.3	17.6	3.702										
16.000	229.937	4.349	501.1	-222.14	1.171	401.9	17.1	3.934										
17.000	249.739	4.006	489.4	-223.51	1.170	403.4	16.6	4.156										
18.000	272.337	3.672	478.6	-224.78	1.168	404.7	16.2	4.418										
19.000	295.776	3.381	468.5	-225.95	1.167	406.0	15.8	4.683										
20.000	319.773	3.127	459.2	-227.03	1.166	407.1	15.5	4.948										
21.000	344.241	2.905	450.6	-228.04	1.165	408.2	15.1	5.212										
22.000	369.091	2.709	442.5	-228.99	1.164	409.2	14.8	5.474										
23.000	394.234	2.537	434.8	-229.87	1.163	410.2	14.5	5.733										
24.000	419.589	2.383	427.7	-230.71	1.162	411.1	14.3	5.989										
25.000	445.076	2.247	420.9	-231.49	1.161	411.9	14.0	6.239										
26.000	470.623	2.125	416.5	-232.23	1.160	412.7	13.8	6.485										
27.000	496.148	2.015	412.5	-232.94	1.159	413.4	13.6	6.726										
28.000	521.656	1.917	407.7	-233.60	1.158	414.1	13.3	6.960										
29.000	547.043	1.828	397.2	-234.24	1.158	414.8	13.1	7.188										
30.000	572.295	1.747	392.0	-234.84	1.157	415.4	12.9	7.410										
31.000	597.351	1.674	387.0	-235.42	1.156	416.0	12.8	7.624										
32.000	622.117	1.609	382.3	-235.97	1.155	416.6	12.6	7.832										
33.000	650.210	1.538	377.7	-236.49	1.155	417.1	12.4	8.079										
34.000	680.152	1.470	373.3	-237.00	1.154	417.7	12.3	8.363										
35.000	710.524	1.407	369.2	-237.48	1.154	418.2	12.1	8.607										
36.000	741.026	1.349	365.1	-237.95	1.153	418.7	11.9	8.846										
37.000	772.647	1.295	361.2	-238.40	1.153	419.1	11.8	9.135										
38.000	805.978	1.244	357.5	-238.83	1.152	419.6	11.7	9.399										
39.000	835.411	1.196	353.9	-239.24	1.152	420.0	11.6	9.625										
40.000	867.936	1.152	350.4	-239.64	1.151	420.4	11.4	9.843										
41.000	900.519	1.109	347.0	-240.02	1.151	420.8	11.3	10.052										
42.000	932.937	1.072	343.8	-240.41	1.150	421.2	11.2	10.447										
43.000	965.758	1.035	340.6	-240.77	1.150	421.6	11.1	10.706										
44.000	998.757	1.001	337.6	-241.12	1.149	421.9	11.0	10.962										
45.000	1031.965	0.968	334.5	-241.46	1.149	422.3	10.9	11.211										
46.000	1065.177	0.939	331.4	-241.79	1.149	422.6	10.8	11.470										
47.000	1098.548	0.910	328.9	-242.11	1.148	422.9	10.7	11.721										
48.000	1131.995	0.883	326.2	-242.42	1.148	423.3	10.6	11.969										
49.000	1165.496	0.858	323.2	-242.73	1.147	423.5	10.5	12.215										
50.000	1199.049	0.834	320.4	-243.03	1.147	423.8	10.4	12.457										
7.023	68.096	14.996	922.4	-199.31	1.197	376.6	25.2	1.717	376.6	384.2	398.9	401.8	1.540	1.644				

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 O2 1.14 -3.08 73.
 LM2 20.4 H2 0.071 -1.887 27.

BULK DENSITY = .225 GM/CC
 MIXTURE RATIO = 2.704 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 609.47 EU/100GMS

CHAMBER

THROAT

	FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	549.8
TEMP, DEG K	2304.5	1906.7	1563.8	1269.2	1018.9	892.4	810.0	638.9	501.3	391.8	305.3	234.5	2039.5
ENTHALPY (-)	32.30	83.82	126.27	160.92	188.90	202.52	211.24	228.94	242.86	253.75	262.25	269.13	66.87
CP	1.3213	1.2665	1.2078	1.1440	1.0914	1.0657	1.0503	1.0203	1.0022	.9881	.9767	.9671	1.2870
IMPUL OPT		211.72	285.93	334.52	369.10	384.82	394.56	413.61	427.99	438.93	447.27	453.92	173.42
IMPUL VAC		316.05	349.29	378.47	401.08	411.69	418.34	431.50	441.56	449.27	455.18	459.90	309.66
EPSILON		1.058	1.613	2.811	5.137	7.377	9.597	18.139	34.545	66.134	127.013	241.480	1.000

	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	551.2
TEMP, DEG K	2304.5	1911.6	1568.8	1273.6	1022.7	895.9	813.2	641.6	503.4	393.5	306.7	235.7	2044.7
ENTHALPY (-)	32.30	83.89	126.44	161.19	189.25	202.91	211.66	229.43	243.40	254.33	262.87	269.77	66.75
X BAR	13.400	13.394	13.393	13.393	13.393	13.393	13.393	13.393	13.393	13.393	13.393	13.393	13.395
N	13.400	13.394	13.393	13.393	13.393	13.393	13.393	13.393	13.393	13.393	13.393	13.393	13.395
CP	1.3629	1.2748	1.2095	1.1449	1.0920	1.0664	1.0506	1.0203	1.0022	.9876	.9759	.9673	1.3027
IMPUL OPT		211.85	286.18	334.86	369.51	385.27	395.02	414.12	428.54	439.51	447.87	454.52	173.13
IMPUL VAC		316.33	349.65	378.90	401.56	412.19	418.86	432.06	442.15	449.87	455.80	460.53	309.90
EPSILON		1.058	1.614	2.813	5.142	7.385	9.608	18.161	34.592	66.229	127.219	241.984	1.000

	COMPOSITION SHIFTING (MOL/100 GM)												
52.10 H	.0130	.0018	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0039
9.33 H2O	.0011	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
.00 H2	8.8244	8.8295	8.8303	8.8304	8.8304	8.8304	8.8304	8.8304	8.8304	8.8304	8.8304	8.8304	8.8285
-57.80 H2O	4.5614	4.5624	4.5625	4.5625	4.5625	4.5625	4.5625	4.5625	4.5625	4.5625	4.5625	4.5625	4.5623
59.56 O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

SYSTEM LIQUID BIPROPELLANT
COMPONENT TREF FORMULA
PC 1000, PSIA
DENSITY
GR/CC
HEAT FORM
(KCAL/FORM.WT.)
WT. 0/0

LOX
LM2
DEG K
20.4 M2
0.071
-1.007

PC STAR = 7073.4 FT/SEC

EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL / I OPT	DELTVAC	DELTVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC
				DEG K	GM DEG	/P	/P	LVL	10000	50000		LVL	
1.000	1.000	1000.000	2304.5	-12.30	1.331								
1.000	1.019	549.776	2039.5	-66.87	1.287	173.4	136.2	248	306.0	307.1	309.2	1.235	1.250
2.000	9.889	101.123	1634.3	-141.79	1.181	309.4	52.7	521	354.5	356.0	361.2	1.430	1.461
3.000	17.685	56.565	1239.1	-184.56	1.138	339.0	42.3	748	370.3	373.6	380.0	1.494	1.539
4.000	28.013	35.472	1115.6	-178.26	1.112	356.4	36.2	1014	377.7	382.2	390.9	1.524	1.584
5.000	38.404	26.038	1028.9	-187.80	1.094	367.8	32.4	1244	381.6	387.4	398.1	1.561	1.615
6.000	50.340	19.865	962.6	-194.99	1.080	376.2	29.6	1492	383.9	390.5	403.3	1.599	1.638
7.000	63.101	15.867	909.8	-200.67	1.069	382.7	27.5	1738	384.7	392.4	407.3	1.552	1.655
8.000	76.731	13.032	866.2	-205.31	1.061	388.0	25.9	1985	393.4	401.4	413.8	1.670	
9.000	91.145	10.969	829.4	-209.20	1.054	392.3	24.5	2233	393.9	413.0	416.8	1.682	
10.000	106.315	9.406	797.8	-212.52	1.048	396.0	23.3	2481		415.1	419.3	1.692	
11.000	122.566	8.159	770.1	-215.42	1.043	399.1	22.3	2739		416.8	421.5	1.701	
12.000	139.525	7.167	745.6	-217.97	1.038	401.4	21.5	2998		418.3	423.4	1.708	
13.000	157.051	6.367	723.7	-220.24	1.035	404.4	20.7	3255		419.5	425.1	1.715	
14.000	174.958	5.714	704.0	-222.27	1.031	406.5	20.1	3509		420.6	426.6	1.721	
15.000	193.232	5.175	686.0	-224.12	1.028	408.5	19.4	3758		421.6	428.0	1.727	
16.000	211.636	4.725	669.7	-225.80	1.025	410.5	18.9	4001		422.4	429.2	1.732	
17.000	230.120	4.366	654.6	-227.33	1.023	411.9	18.4	4236		423.1	430.3	1.736	
18.000	248.619	4.022	640.8	-228.75	1.021	413.4	18.0	4464		423.8	431.4	1.741	
19.000	268.449	3.711	627.9	-230.06	1.019	414.8	17.5	4692		424.3	432.3	1.745	
20.000	291.175	3.434	615.9	-231.28	1.017	416.1	17.1	4923		424.7	433.2	1.748	
21.000	313.356	3.191	604.7	-232.42	1.015	417.3	16.8	5156		425.1	434.0	1.751	
22.000	336.041	2.976	594.3	-233.49	1.014	418.4	16.5	5388		425.4	434.8	1.755	
23.000	359.041	2.785	584.4	-234.49	1.013	419.4	16.3	5619		425.7	435.4	1.758	
24.000	382.324	2.616	575.1	-235.43	1.011	420.4	15.8	5857		425.9	436.2	1.760	
25.000	405.825	2.466	566.3	-236.31	1.010	421.3	15.6	6091		426.1	436.9	1.763	
26.000	429.418	2.328	558.0	-237.15	1.009	422.2	15.3	6324		426.3	437.5	1.765	
27.000	453.224	2.204	550.1	-237.95	1.008	423.0	15.1	6556		426.4	438.0	1.768	
28.000	477.058	2.096	542.7	-238.70	1.007	423.8	14.8	6787		426.5	438.6	1.770	
29.000	500.783	1.997	535.5	-239.42	1.006	424.5	14.6	7017		426.6	439.1	1.772	
30.000	524.507	1.907	528.7	-240.11	1.005	425.2	14.4	7244		426.7	439.6	1.774	
31.000	548.147	1.824	522.2	-240.76	1.005	425.9	14.2	7469		426.8	440.1	1.776	
32.000	571.674	1.749	516.0	-241.38	1.004	426.5	14.0	7691		426.8	440.5	1.778	
33.000	595.075	1.680	510.0	-241.98	1.003	427.1	13.8	7911		426.9	440.9	1.779	
34.000	618.334	1.617	504.3	-242.55	1.003	427.7	13.7	8128		427.0	441.3	1.781	
35.000	641.425	1.554	498.8	-243.10	1.002	428.2	13.5	8342		427.1	441.7	1.782	
36.000	671.125	1.490	493.5	-243.63	1.001	428.6	13.3	8554		427.1	442.1	1.783	
37.000	699.226	1.430	488.4	-244.14	1.000	429.3	13.2	8763		427.2	442.5	1.785	
38.000	727.674	1.374	483.5	-244.63	1.000	429.8	13.0	8968		427.2	442.8	1.787	
39.000	756.457	1.322	478.8	-245.11	1.000	430.3	12.9	9170		427.3	443.2	1.788	
40.000	785.549	1.273	474.2	-245.56	1.000	430.7	12.8	9369		427.3	443.5	1.790	
41.000	814.927	1.227	469.8	-246.01	1.000	431.2	12.6	9565		427.4	443.8	1.791	
42.000	844.568	1.184	465.5	-246.43	1.000	431.6	12.5	9758		427.4	444.1	1.792	
43.000	874.446	1.144	461.4	-246.84	1.000	432.0	12.4	9948		427.4	444.4	1.793	
44.000	904.537	1.106	457.4	-247.24	1.000	432.4	12.3	10134		427.4	444.7	1.794	
45.000	934.815	1.070	453.5	-247.63	1.000	432.8	12.1	10317		427.4	445.0	1.795	
46.000	965.267	1.036	449.7	-248.01	1.000	433.2	12.0	10497		427.4	445.2	1.797	
47.000	995.850	1.004	446.1	-248.37	1.000	433.6	11.9	10674		427.4	445.5	1.798	
48.000	1026.572	0.974	442.5	-248.72	1.000	433.9	11.8	10848		427.4	445.7	1.799	
49.000	1057.385	0.946	438.9	-249.07	1.000	434.3	11.7	11019		427.4	446.0	1.800	
50.000	1088.278	0.919	435.7	-249.40	1.000	434.6	11.6	11187		427.4	446.2	1.801	
7.377	68.046	14.696	892.4	-202.52	1.066	384.8	26.9	1.828	384.8	392.9	409.6	1.117	1.553

SHIFTING EXPANSION

C STAR = 7082.7 FT/SEC

EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL / I	OPT	DELTVAC	DELTVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC
				DEG K	GM DEG		/P	/P	LVL	10000	50000		LVL	
1.000	1.000	1000.000	2304.5	-12.30	1.363									
1.000	1.019	551.240	2044.7	-64.75	1.303	173.1	136.8	248	306.3	307.3	309.9	1.249	1.234	
2.000	9.874	101.776	1639.5	-141.95	1.182	309.7	52.8	522	354.8	357.1	361.6	1.430	1.461	
3.000	17.661	56.621	1243.9	-184.59	1.138	339.3	42.4	749	370.7	374.0	380.4	1.494	1.538	
4.000	27.956	35.719	1120.0	-176.53	1.112	356.8	36.3	1015	378.1	382.6	391.3	1.524	1.584	
5.000	38.350	26.070	1031.1	-188.11	1.094	368.2	32.5	1244	382.4	387.9	398.5	1.561	1.615	
6.000	50.247	19.894	966.7	-195.33	1.081	376.6	29.7	1494	384.4	391.0	403.8	1.599	1.638	
7.000	63.008	15.871	913.7	-201.02	1.070	383.1	27.6	1740	385.2	392.9	407.8	1.552	1.655	
8.000	76.611	13.053	870.0	-205.67	1.061	388.4	25.9	1987	393.9	401.9	414.3	1.670		
9.000	91.022	10.986	831.1	-209.58	1.054	392.7	24.6	2235	394.3	413.5	417.3	1.682		
10.000	106.119	9.427	801.5	-212.92	1.048	396.4	23.4	2484		415.4	419.6	1.692		
11.000	122.338	8.173	773.5	-215.82	1.043	399.6	22.4	2742		417.3	423.0	1.701		
12.000	139.287	7.179	748.9	-218.38	1.039	402.4	21.5	3001		418.8	425.9	1.709		
13.000	156.782	6.378	727.0	-220.66	1.035	404.8	20.8	3259		420.0	428.6	1.715		
14.000	174.858	5.724	707.2	-222.71	1.031	407.0	20.1	3513		421.1	431.1	1.722		
15.000	192.803	5.184	689.2	-224.56	1.028	409.0	19.5	3763		422.1	433.5	1.727		
16.000	211.279	4.733	672.8	-226.24	1.025	410.8	19.0	4006		422.9	435.7	1.732		
17.000	229.735	4.393	657.7	-227.79	1.023	412.4	18.5	4241		423.6	437.9	1.737		
18.000	248.208	4.029	643.7	-229.21	1.021	413.9	18.0	4470		424.3	439.9	1.741		
19.000	268.940	3.718	630.8	-230.53	1.019	415.3	17.6	4693		424.8	441.9	1.745		
20.000	290.622	3.441	618.8	-231.75	1.017	416.6	17.2	4918		425.2	443.8	1.748		
21.000	312.759	3.197	607.6	-232.89	1.015	417.8	16.8	5146		425.6	445.6	1.752		
22.000	335.400	2.982	597.0	-233.96	1.014	418.9	16.5	5374		425.9	447.4	1.755		
23.000	358.357	2.791	587.2	-234.97	1.013	419.9	16.2	5600		426.2	449.1	1.758		
24.000	381.598	2.621	577.8	-235.91	1.011	420.9	15.9	5824		426.4	450.8	1.760		
25.000	405.058	2.469	569.0	-236.80	1.010	421.8	15.6	6046		426.6	452.4	1.763		
26.000	428.673	2.333	560.7	-237.64	1.009	422.7	15.4	6268		426.8	453.9	1.765		
27.000	452.382	2.211	552.8	-238.44	1.008	423.5	15.1	6489		426.9	455.4	1.768		
28.000	476.131	2.100	545.2	-239.20	1.007	424.3	14.9	6703		427.1	456.9	1.770		
29.000	499.872	2.001	538.1	-239.92	1.006	425.0	14.7	6917		427.2	458.3	1.772		
30.000	523.566	1.910	531.2	-240.61	1.006	425.7	14.4	7130		427.3	459.7	1.774		
31.000	547.173	1.828	524.7	-241.26	1.005	426.4	14.2	7342		427.3	461.0	1.776		
32.000	570.615	1.752	518.9	-241.89	1.004	427.1	14.1	7554		427.4	462.3	1.778		
33.000	594.058	1.685	515.5	-242.49	1.003	427.6	13.9	7767						
34.000	617.277	1.620	506.7	-243.07	1.003	428.2	13.7	7979						
35.000	642.131	1.557	501.2	-243.62	1.002	428.8	13.5	8191						
36.000	669.780	1.493	495.9	-244.15	1.001	429.3	13.4	8397						
37.000	698.811	1.437	491.0	-244.67	1.000	429.8	13.2	8600						
38.000	726.159	1.377	485.9	-245.16	1.000	430.3	13.1	8802						
39.000	756.921	1.325	481.1	-245.63	.999	430.8	12.9	9000						
40.000	783.953	1.276	476.5	-246.09	.999	431.3	12.8	9204						
41.000	813.272	1.230	472.1	-246.53	.998	431.7	12.7	9404						
42.000	844.900	1.182	467.9	-246.96	.998	432.1	12.6	9600						
43.000	872.673	1.140	463.6	-247.38	.997	432.6	12.4	9808						
44.000	902.706	1.100	459.6	-247.78	.996	433.0	12.3	11093						
45.000	932.931	1.072	455.7	-248.17	.996	433.4	12.2	11197						
46.000	963.321	1.047	451.8	-248.55	.995	433.8	12.1	11299						
47.000	993.859	1.026	448.3	-248.91	.995	434.1	12.0	11880						
48.000	1024.518	.976	444.7	-249.26	.994	434.5	11.8	12140						
49.000	1055.279	.948	441.2	-249.61	.994	434.8	11.7	12797						
50.000	1086.119	.921	437.7	-249.94	.994	435.1	11.6	12652						
		1.620	434.2	-250.27	1.006	435.6			185.3	393.4	409.1	1.583		

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 O2 1.14 -3.08 80.
 LM2 20.4 H2 0.071 -1.887 20.

BULK DENSITY = .284 GM/CC
 MIXTURE RATIO = 4.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 513.80 EU/100GMS

	CHAMBER											THROAT	
		FROZEN EXPANSION											
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	557.3
TEMP, DEG K	2976.0	2513.5	2110.5	1759.2	1453.5	1294.5	1188.4	961.3	769.9	611.4	482.5	379.2	2675.0
ENTHALPY (-)	26.42	76.58	118.83	154.19	183.54	198.17	207.67	227.30	243.10	255.69	265.68	273.51	59.24
CP	1.1002	1.0671	1.0282	.9834	.9347	.9053	.8853	.8420	.8082	.7828	.7654	.7527	1.0798
IMPUL OPT		208.89	283.55	333.40	369.72	386.55	397.09	418.04	434.17	446.61	456.23	463.64	168.98
IMPUL VAC		312.96	347.92	379.04	403.72	415.51	422.98	437.93	449.51	458.45	465.38	470.72	305.90
EPSILON		1.064	1.653	2.944	5.510	8.022	10.536	20.333	39.384	76.382	148.208	287.922	1.000
		SHIFTING EXPANSION											
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	561.8
TEMP, DEG K	2976.0	2570.7	2184.8	1831.9	1519.5	1356.4	1247.2	1012.7	813.9	648.4	513.0	403.9	2720.7
ENTHALPY (-)	26.42	77.03	120.23	156.65	187.02	202.20	212.08	232.54	249.07	262.30	272.80	281.09	59.00
X BAR	10.005	9.949	9.927	9.921	9.921	9.921	9.921	9.921	9.921	9.921	9.921	9.921	9.965
N	10.005	9.949	9.927	9.921	9.921	9.921	9.921	9.921	9.921	9.921	9.921	9.921	9.965
CP	1.4346	1.2144	1.0774	.9998	.9458	.9155	.8947	.8506	.8139	.7855	.7667	.7527	1.2878
IMPUL OPT		209.82	285.67	336.59	373.78	391.05	401.89	423.46	440.11	453.00	462.97	470.70	168.35
IMPUL VAC		315.20	351.31	383.27	408.65	420.80	428.51	443.97	455.97	465.27	472.48	478.06	307.57
EPSILON		1.068	1.671	2.985	5.601	8.168	10.740	20.789	40.382	78.507	152.679	296.996	1.000
		COMPOSITION SHIFTING (MOL/100 GM)											
52.10 H	.1236	.0455	.0109	.0016	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0691
9.33 H2O	.0426	.0108	.0016	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0191
.00 H2	4.8813	4.9034	4.9160	4.9199	4.9206	4.9206	4.9206	4.9206	4.9206	4.9206	4.9206	4.9206	4.8959
-57.80 H2O	4.9562	4.9891	4.9984	4.9999	5.0000	5.0000	5.0000	5.0000	5.0000	5.0000	5.0000	5.0000	4.9806
59.56 O	.0006	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
.00 O2	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000, PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/G
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 O2 1.14 -3.08 85.
 LM2 20.4 H2 0.071 -1.887 15.

BULK DENSITY = .350 GM/CC
 MIXTURE RATIO = 5.667 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 438.04 EU/100GMS

CHAMBER	FROZEN EXPANSION												THROAT
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	561.4
TEMP, DEG K	3452.1	2951.5	2513.1	2128.4	1790.9	1613.8	1494.7	1235.4	1010.2	817.3	654.9	520.7	3130.6
ENTHALPY (-)	22.22	67.57	106.25	139.11	166.84	180.89	190.10	209.42	225.31	238.23	248.64	256.95	51.47
CP	.9165	.8941	.8689	.8388	.8037	.7817	.7651	.7241	.6866	.6542	.6282	.6102	.9030
IMPUL OPT	198.62	270.37	318.88	354.71	371.53	382.17	403.56	420.34	433.50	443.82	451.89	459.52	159.52
IMPUL VAC	298.17	332.64	363.60	388.53	400.63	408.37	424.07	436.44	446.13	453.71	459.61	459.99	290.99
EPSILON	1.068	1.678	3.026	5.750	8.455	11.188	21.996	43.378	85.478	168.050	329.634	1.000	

	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	572.6
TEMP, DEG K	3452.1	3120.1	2792.5	2458.9	2124.0	1935.9	1806.4	1519.2	1265.0	1042.3	849.7	686.0	3249.7
ENTHALPY (-)	22.22	68.43	109.40	145.44	176.71	192.81	203.45	226.07	244.99	260.67	273.51	283.94	50.85
X BAR	7.749	7.621	7.527	7.471	7.448	7.443	7.442	7.441	7.440	7.440	7.440	7.440	7.668
N	7.749	7.621	7.527	7.471	7.448	7.443	7.442	7.441	7.440	7.440	7.440	7.440	7.668
CP	2.0055	1.6647	1.3203	1.0496	.8909	.8388	.8124	.7654	.7229	.6848	.6509	.6228	1.8035
IMPUL OPT	200.50	275.40	327.41	366.61	385.23	397.07	421.12	440.23	455.46	467.57	477.17	477.80	157.80
IMPUL VAC	303.03	341.38	375.92	403.91	417.57	426.34	444.32	458.71	470.18	479.26	486.41	486.41	294.32
EPSILON	1.080	1.746	3.225	6.229	9.229	12.276	24.450	48.918	97.860	195.216	387.902	1.000	

	COMPOSITION SHIFTING (MOL/100 GM)												
52.10 H	.2630	.1740	.0965	.0400	.0109	.0041	.0018	.0002	.0000	.0000	.0000	.0000	.2081
9.33 H2O	.2807	.1580	.0693	.0205	.0035	.0009	.0003	.0000	.0000	.0000	.0000	.0000	.2029
.00 H2	2.1908	2.1421	2.1202	2.1190	2.1243	2.1264	2.1272	2.1279	2.1280	2.1280	2.1280	2.1280	2.1581
-57.80 H2O	4.9778	5.1324	5.2374	5.2913	5.3090	5.3116	5.3122	5.3125	5.3125	5.3125	5.3125	5.3125	5.0769
59.56 C	.0193	.0076	.0019	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0114
.00 O2	.0174	.0073	.0019	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0107

SYSTEM LIQUID RIPOPELLANT
COMPONENT I REF FORMULA
LOX DEG K
LMZ 20.4 HZ

PC 1000, PSIA
DENSITY
GM/CC
1.14
0.071

HEAT FORM
(KCAL/FORM.WT.)
-1.08
-1.887

WT. 0/0
85.
15.

EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	FROZEN EXPANSION		I SEA	I AT	I AT	I VAC	CF SEA	CF VAC
					CP CAL/ I	OPT DELVAC						
DEG K	DEG K	DEG K	DEG K	DEG K	GM DEG	DEG K	LVL	10000	50000	LVL	LVL	LVL
1.000	1.000	1000.000	3652.1	-22.22	-916	159.5	131.5	234	287.4	286.6	290.6	291.0
1.761	1.761	111.000	3110.6	-51.47	-903	159.5	131.5	234	287.4	286.6	290.6	291.0
2.000	2.000	111.000	2381.7	-117.62	-860	288.8	54.4	488	136.0	338.2	362.4	363.2
3.000	3.000	15.736	63.549	2131.2	-138.71	839	318.4	44.8	706	152.9	356.0	362.0
4.000	4.000	26.400	40.984	1973.4	-152.00	824	336.1	39.2	958	361.3	365.5	373.7
5.000	5.000	33.327	30.000	1859.0	-161.35	811	348.0	35.7	1191	366.2	371.5	381.7
6.000	6.000	42.316	23.032	1770.5	-168.48	801	358.7	33.2	1407	369.3	375.5	387.6
7.000	7.000	52.587	19.016	1678.5	-174.22	793	363.7	31.3	1645	370.8	378.0	392.1
8.000	8.000	63.157	15.875	1618.2	-178.98	785	369.3	29.7	1877	371.4	379.7	395.8
9.000	9.000	74.237	13.471	1586.6	-183.01	778	374.0	28.4	2109	380.8	398.8	402.4
10.000	10.000	85.938	11.667	1561.5	-186.50	772	378.1	27.3	2345	381.3	401.4	409.4
11.000	11.000	97.747	10.231	1501.7	-189.57	766	381.4	26.4	2577		401.5	407.9
12.000	12.000	110.310	9.005	1466.0	-192.29	761	384.7	25.5	2816		405.4	410.2
13.000	13.000	123.420	8.102	1433.8	-194.74	756	387.4	24.8	3060		407.0	412.2
14.000	14.000	136.924	7.303	1404.4	-196.95	751	389.9	24.1	3304		408.4	414.0
15.000	15.000	150.746	6.634	1377.6	-198.96	747	392.1	23.5	3548		409.6	415.7
16.000	16.000	164.817	6.067	1352.8	-200.81	743	394.2	23.0	3788		410.7	417.2
17.000	17.000	179.069	5.584	1329.8	-202.52	740	396.1	22.5	4027		411.7	418.5
18.000	18.000	193.441	5.170	1308.4	-204.09	736	397.8	22.0	4262		412.5	419.8
19.000	19.000	207.961	4.810	1288.4	-205.56	733	399.4	21.6	4492		413.3	421.0
20.000	20.000	222.367	4.497	1269.7	-206.93	730	400.9	21.2	4717		414.0	422.1
21.000	21.000	236.808	4.223	1252.0	-208.22	727	402.3	20.8	4937		414.7	423.1
22.000	22.000	251.249	3.980	1235.4	-209.43	724	403.6	20.5	5152		415.3	424.1
23.000	23.000	265.715	3.755	1219.6	-210.57	721	404.8	20.2	5363		415.8	425.0
24.000	24.000	280.447	3.553	1204.4	-211.65	718	406.0	19.9	5568		416.2	425.8
25.000	25.000	295.308	3.371	1190.4	-212.67	717	407.0	19.6	5766		416.6	426.6
26.000	26.000	310.254	3.217	1176.8	-213.64	714	408.1	19.3	5958		416.9	427.4
27.000	27.000	325.253	3.076	1163.9	-214.56	712	409.1	19.1	6145		417.2	428.1
28.000	28.000	340.317	2.945	1151.5	-215.44	710	410.0	18.8	6328		417.5	428.8
29.000	29.000	355.414	2.820	1139.7	-216.28	708	410.9	18.6	6507		417.7	429.5
30.000	30.000	369.774	2.706	1128.3	-217.09	706	411.7	18.4	6681		417.9	430.1
31.000	31.000	384.331	2.602	1117.4	-217.86	705	412.6	18.1	6850		418.1	430.7
32.000	32.000	398.957	2.506	1107.0	-218.59	703	413.3	17.9	7014		418.2	431.3
33.000	33.000	413.647	2.416	1097.0	-219.30	701	414.1	17.7	7173		418.4	431.8
34.000	34.000	427.318	2.331	1087.2	-219.98	700	414.8	17.6	7328		418.5	432.3
35.000	35.000	440.959	2.251	1077.8	-220.64	698	415.5	17.4	7479		418.6	432.9
36.000	36.000	454.681	2.175	1068.7	-221.27	696	416.1	17.2	7626		418.7	433.3
37.000	37.000	468.381	2.103	1060.0	-221.88	695	416.6	17.0	7769		418.8	433.8
38.000	38.000	482.054	2.035	1051.5	-222.46	694	417.4	16.9	7908		418.9	434.3
39.000	39.000	495.733	1.970	1043.3	-223.03	692	418.0	16.7	8045		419.0	434.7
40.000	40.000	509.430	1.908	1035.4	-223.58	691	418.5	16.6	8179		419.0	435.1
41.000	41.000	523.144	1.848	1027.7	-224.11	690	419.1	16.4	8311		419.1	435.5
42.000	42.000	536.870	1.789	1020.2	-224.64	688	419.6	16.3	8441		419.2	435.9
43.000	43.000	550.608	1.732	1012.9	-225.15	687	420.1	16.2	8568		419.3	436.3
44.000	44.000	564.358	1.675	1005.9	-225.64	686	420.6	16.0	8694		419.4	436.7
45.000	45.000	578.114	1.620	999.0	-226.11	685	421.1	15.9	8819		419.5	437.0
46.000	46.000	591.876	1.565	992.3	-226.56	684	421.6	15.8	8944		419.6	437.4
47.000	47.000	605.647	1.511	985.8	-227.00	683	422.1	15.7	9068		419.7	437.8
48.000	48.000	619.414	1.457	979.5	-227.42	682	422.5	15.5	9191		419.8	438.0
49.000	49.000	633.181	1.403	973.3	-227.84	680	422.9	15.4	9314		419.9	438.4
50.000	50.000	646.944	1.350	967.2	-228.25	679	423.4	15.3	9437		420.0	438.7
51.000	51.000	660.708	1.296	961.3	-228.65	678	423.8	15.2	9559		420.1	439.1

EPSILON	PC/P	P PSIA	TEMP DEG K	ENTHALPY KCAL/100G	SHIFTING EXPANSION		I SEA LVL	I AT 10000	I AT 50000	I VAC	CF SEA LVL	CF VAC
					CP CAL/G	I OPT DELVAC DEG F						
1.000	1.000	1000.000	3652.1	-22.22	2.006	157.8	136.5	239	290.8	291.9	294.3	294.3
2.000	1.746	1722.640	3249.7	-50.85	1.804	290.8	55.1	491	343.0	345.1	349.3	350.2
3.000	4.166	1222.453	2712.8	-114.59	1.246	290.8	100.1	891	343.0	345.1	349.3	350.2
4.000	6.674	67.247	2395.5	-141.79	1.076	322.8	44.7	736	361.6	364.9	371.2	372.4
5.000	21.942	65.574	1949.8	-161.70	985	341.7	44.2	970	371.7	376.0	384.3	385.5
6.000	34.000	33.262	2233.1	-168.97	932	354.9	40.5	1217	377.5	382.9	393.3	394.4
7.000	48.000	26.307	2162.4	-175.09	897	368.7	37.9	1467	381.4	387.8	400.1	402.5
8.000	60.843	21.947	2087.1	-181.67	873	372.5	35.7	1671	383.6	391.0	405.3	408.2
9.000	50.274	17.515	1997.6	-186.98	855	378.8	34.0	1913	384.7	393.2	409.6	412.6
10.000	65.816	15.196	1947.6	-191.83	841	384.1	32.6	2147	385.2	394.7	413.1	416.8
11.000	75.233	13.171	1498.8	-195.48	831	388.7	31.4	2386	395.6	416.1	420.1	424.0
12.000	87.033	10.306	1816.5	-199.45	822	392.7	30.2	2626	396.1	418.6	423.2	427.5
13.000	97.148	10.306	1816.5	-202.83	814	396.2	29.5	2862	396.3	420.8	425.7	430.0
14.000	110.811	9.346	1748.8	-208.09	808	402.1	28.0	3152	397.4	422.7	430.1	434.4
15.000	131.747	7.750	1719.2	-210.47	797	404.7	27.3	3600	398.6	424.4	432.0	436.3
16.000	143.944	6.947	1691.7	-212.65	792	407.0	26.7	3848	399.7	427.2	433.8	438.0
17.000	160.499	6.067	1662.5	-214.52	788	409.2	26.2	4095	400.8	428.4	435.4	439.5
18.000	180.434	5.170	1642.5	-216.53	784	411.2	25.7	4340	401.9	429.4	436.8	440.7
19.000	181.954	5.507	1620.2	-218.27	781	413.0	25.2	4582	403.0	430.4	438.2	442.9
20.000	194.444	5.146	1594.3	-219.90	778	414.7	24.8	4820	411.3	431.3	439.5	444.8
21.000	207.133	4.628	1579.5	-221.43	775	416.3	24.4	5054	432.1	440.7	448.9	451.0
22.000	219.320	4.219	1560.9	-222.86	772	417.8	24.0	5285	433.5	442.9	450.9	453.1
23.000	237.177	4.237	1543.2	-224.22	769	419.2	23.7	5510	433.5	442.9	450.9	453.1
24.000	245.465	4.676	1526.4	-225.51	767	420.5	23.3	5731	434.1	443.9	451.0	453.1
25.000	259.135	3.959	1510.5	-226.73	764	421.8	23.0	5949	434.7	444.8	451.0	453.1
26.000	273.799	3.641	1495.3	-227.89	761	423.0	22.7	6164	435.1	445.7	451.0	453.1
27.000	288.401	3.085	1480.7	-229.00	759	424.1	22.5	6378	435.5	446.6	451.0	453.1
28.000	303.639	3.294	1466.8	-230.05	757	425.2	22.2	6589	435.9	447.4	451.0	453.1
29.000	318.852	3.110	1453.3	-231.06	755	426.2	21.9	6798	436.3	448.2	451.0	453.1
30.000	334.218	2.492	1440.7	-232.02	752	427.2	21.7	7004	436.6	448.9	451.0	453.1
31.000	349.715	2.047	1428.3	-232.94	750	428.2	21.5	7208	436.8	449.6	451.0	453.1
32.000	365.324	2.737	1416.6	-233.85	748	429.1	21.2	7411	437.1	450.3	451.0	453.1
33.000	381.024	2.625	1405.2	-234.69	746	429.9	21.0	7614	437.3	450.9	451.0	453.1
34.000	396.796	2.520	1394.2	-235.51	745	430.8	20.8	7819	437.5	451.6	451.0	453.1
35.000	412.621	2.424	1383.5	-236.30	743	431.6	20.6	8027	437.7	452.2	451.0	453.1
36.000	428.482	2.334	1373.1	-237.05	741	432.4	20.4	8233	437.9	452.8	451.0	453.1
37.000	444.361	2.250	1363.3	-237.79	739	433.1	20.2	8446	438.0	453.3	451.0	453.1
38.000	460.245	2.173	1353.7	-238.50	738	433.8	20.1	8657	438.1	453.9	451.0	453.1
39.000	476.118	2.100	1346.4	-239.19	736	434.5	19.9	8875	438.2	454.4	451.0	453.1
40.000	491.988	2.030	1339.8	-239.86	734	435.1	19.7	9090	438.3	454.9	451.0	453.1
41.000	507.784	1.969	1329.6	-240.50	733	435.8	19.6	9301	438.4	455.4	451.0	453.1
42.000	523.516	1.910	1318.0	-241.13	732	436.4	19.4	10.170	438.5	455.8	451.0	453.1
43.000	539.275	1.854	1309.7	-241.73	730	437.0	19.3	10.195	438.5	456.3	451.0	453.1
44.000	554.936	1.802	1301.7	-242.32	729	437.5	19.1	10.617	438.6	456.7	451.0	453.1
45.000	570.521	1.754	1293.1	-242.89	728	438.0	18.9	11.039	438.6	457.2	451.0	453.1
46.000	586.098	1.706	1286.2	-243.45	726	438.7	18.9	11.051	438.7	457.7	451.0	453.1
47.000	601.594	1.662	1278.7	-243.99	725	439.4	18.7	11.264	438.8	458.0	451.0	453.1
48.000	616.897	1.621	1271.5	-244.52	724	439.8	18.6	11.473	438.9	458.4	451.0	453.1
49.000	632.427	1.581	1264.6	-245.04	723	440.2	18.5	11.683	439.0	458.8	451.0	453.1
50.000	648.073	1.537	1257.5	-245.53	722	440.5	18.4	11.937	439.1	459.2	451.0	453.1
9.228	80.000	14.696	1935.9	-192.81	839	385.2	32.3	2.200	385.2	395.0	413.8	417.6

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 1000, PSIA

COMPONENT	TREF FORMULA DEG K	DENSITY GM/CC	HEAT FORM (KCAL/FORM.WT.)	WT. O/O
LOX	90.2 O2	1.14	-3.08	90.
LH2	20.4 H2	.071	-1.887	10.

BULK DENSITY = .455 GM/CC
MIXTURE RATIO = 9.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 354.89 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	1000	396.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	562.4
TEMP, DEG K	3578.7	3074.3	2631.3	2242.1	1899.4	1719.2	1597.9	1332.7	1100.6	899.2	727.1	582.6	3255.9
ENTHALPY (-)	18.02	53.50	83.93	109.90	131.99	143.24	150.63	166.26	179.23	189.88	198.55	205.52	40.82
CP	.7105	.6954	.6774	.6562	.6317	.6158	.6039	.5737	.5434	.5151	.4918	.4737	.7013
IMPUL OPT		175.68	239.45	282.72	314.88	330.05	339.66	359.11	374.49	386.67	396.30	403.88	140.82
IMPUL VAC		263.98	294.89	322.74	345.32	356.33	363.40	377.84	389.32	398.40	405.56	411.16	257.48
EPSILON		1.069	1.687	3.057	5.841	8.622	11.443	22.675	45.103	89.655	177.678	350.881	1.000
	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	396.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	576.4
TEMP, DEG K	3578.7	3292.4	3031.6	2787.6	2551.7	2414.0	2313.5	2063.8	1803.0	1546.5	1309.4	1096.8	3403.9
ENTHALPY (-)	18.02	54.30	87.01	116.54	143.21	157.48	167.19	188.57	207.34	223.57	237.58	249.02	40.17
X BAR	5.837	5.711	5.598	5.500	5.417	5.378	5.355	5.316	5.298	5.294	5.293	5.293	5.760
N	5.836	5.711	5.598	5.500	5.417	5.378	5.355	5.316	5.298	5.294	5.293	5.293	5.760
CP	2.1551	2.0314	1.8472	1.6117	1.3380	1.1726	1.0579	.8232	.6770	.6049	.5638	.5318	2.0897
IMPUL OPT		177.64	244.99	292.76	330.02	348.32	360.24	385.19	405.84	422.87	436.85	448.29	138.82
IMPUL VAC		269.16	304.88	338.03	366.22	380.54	389.97	409.81	428.19	439.61	450.57	459.48	260.93
EPSILON		1.085	1.784	3.387	6.804	10.349	14.032	29.193	60.607	125.202	257.710	528.421	1.000
	COMPOSITION SHIFTING (MOL/100 GM)												
52.10 H	.1386	.0985	.0648	.0380	.0188	.0108	.0067	.0014	.0001	.0000	.0000	.0000	.1738
9.33 H2O	.6294	.4991	.3802	.2739	.1809	.1339	.1039	.0472	.0152	.0032	.0004	.0000	.5501
.00 H2	.4572	.3616	.2701	.1854	.1112	.0750	.0532	.0175	.0033	.0003	.0000	.0000	.3996
-57.80 H2O	4.1192	4.3000	4.4677	4.6190	4.7494	4.8130	4.8519	4.9185	4.9493	4.9584	4.9601	4.9603	4.2288
59.56 O	.1080	.0787	.0542	.0343	.0191	.0124	.0086	.0027	.0005	.0000	.0000	.0000	.0899
.00 O2	.3843	.3736	.3614	.3489	.3378	.3329	.3303	.3283	.3300	.3317	.3322	.3323	.3781

SYSTEM AND/OR REFRIGERANT PS 1998, PIA

COMPONENT	TEMP FORMULA	DENSITY	HEAT FORM	WT. 8/8
DEL K		DE/CC	(KCAL/GRAM.WT.)	
L61	90.3 82	1.16	-3.00	96.
L62	29.5 82	1.07	-1.007	10.

REFRIGERANT

EPSILON	PC/P	P PSIA	TEMP	C YNAM - 5070.5 PYRAC																					
				DEG K		KCAL/TOUCH		BM DEG		CP CAL/		I OPT DELVAC		DELVAC		I SEA		I AT		I VAC		CP SEA		CF VAC	
				DEG	K	KCAL/TOUCH	BM	DEG	DEG	DEG	DEG	DEG	DEG	DEG	DEG	DEG	DEG	DEG	DEG	DEG	DEG	DEG	DEG	DEG	DEG
1.000	1.000	1000.000	3578.7	-18.02	2.155	158.8	116.7	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5	
2.000	0.802	542.403	3255.9	-40.83	1.701	148.6	107.7	207.7	207.7	207.7	207.7	207.7	207.7	207.7	207.7	207.7	207.7	207.7	207.7	207.7	207.7	207.7	207.7	207.7	
3.000	0.607	344.100	2982.3	-63.50	1.257	140.3	98.8	157.8	157.8	157.8	157.8	157.8	157.8	157.8	157.8	157.8	157.8	157.8	157.8	157.8	157.8	157.8	157.8	157.8	
4.000	0.412	217.511	2691.4	-86.21	0.813	132.0	90.0	107.8	107.8	107.8	107.8	107.8	107.8	107.8	107.8	107.8	107.8	107.8	107.8	107.8	107.8	107.8	107.8	107.8	
5.000	0.217	109.018	2378.7	-108.92	0.369	123.7	81.2	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	
6.000	0.022	24.100	1986.5	-131.63	0.022	115.4	72.3	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	
7.000	0.000	0.000	1625.0	-154.34	0.000	107.1	63.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
8.000	0.000	0.000	1312.3	-177.05	0.000	98.8	55.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
9.000	0.000	0.000	999.6	-200.76	0.000	90.5	47.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
10.000	0.000	0.000	687.9	-223.47	0.000	82.2	38.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
11.000	0.000	0.000	376.2	-246.18	0.000	73.9	30.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
12.000	0.000	0.000	62.3	-268.89	0.000	65.6	22.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
13.000	0.000	0.000	0.0	-291.60	0.000	57.3	14.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
14.000	0.000	0.000	0.0	-314.31	0.000	48.9	5.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
15.000	0.000	0.000	0.0	-337.02	0.000	40.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
16.000	0.000	0.000	0.0	-359.73	0.000	32.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
17.000	0.000	0.000	0.0	-382.44	0.000	23.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
18.000	0.000	0.000	0.0	-405.15	0.000	15.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
19.000	0.000	0.000	0.0	-427.86	0.000	7.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
20.000	0.000	0.000	0.0	-450.57	0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
21.000	227.968	6.290	1505.7	-164.85	0.371	357.2	17.2	3.082	357.2	357.2	357.2	357.2	357.2	357.2	357.2	357.2	357.2	357.2	357.2	357.2	357.2	357.2	357.2	357.2	
22.000	261.054	6.135	1345.7	-165.61	0.575	358.6	18.9	4.576	358.6	358.6	358.6	358.6	358.6	358.6	358.6	358.6	358.6	358.6	358.6	358.6	358.6	358.6	358.6	358.6	
23.000	256.277	3.902	1327.6	-166.55	0.573	359.5	18.6	4.774	359.5	359.5	359.5	359.5	359.5	359.5	359.5	359.5	359.5	359.5	359.5	359.5	359.5	359.5	359.5	359.5	
24.000	272.126	2.725	1218.6	-167.63	0.573	360.5	18.8	5.000	360.5	360.5	360.5	360.5	360.5	360.5	360.5	360.5	360.5	360.5	360.5	360.5	360.5	360.5	360.5	360.5	
25.000	284.554	2.084	1054.5	-168.26	0.569	361.5	19.1	5.221	361.5	361.5	361.5	361.5	361.5	361.5	361.5	361.5	361.5	361.5	361.5	361.5	361.5	361.5	361.5	361.5	
26.000	306.617	3.283	1283.9	-169.06	0.560	362.5	19.7	5.444	362.5	362.5	362.5	362.5	362.5	362.5	362.5	362.5	362.5	362.5	362.5	362.5	362.5	362.5	362.5	362.5	
27.000	321.189	3.513	1270.2	-170.19	0.560	363.6	19.8	5.688	363.6	363.6	363.6	363.6	363.6	363.6	363.6	363.6	363.6	363.6	363.6	363.6	363.6	363.6	363.6	363.6	
28.000	337.946	3.959	1258.0	-170.51	0.560	364.2	19.8	5.888	364.2	364.2	364.2	364.2	364.2	364.2	364.2	364.2	364.2	364.2	364.2	364.2	364.2	364.2	364.2	364.2	
29.000	354.854	3.584	1254.9	-171.18	0.560	364.9	19.9	6.110	364.9	364.9	364.9	364.9	364.9	364.9	364.9	364.9	364.9	364.9	364.9	364.9	364.9	364.9	364.9	364.9	
30.000	371.096	2.689	1236.3	-171.85	0.561	365.0	19.9	6.330	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	365.0	
31.000	389.045	2.570	1223.1	-172.87	0.560	365.6	19.8	6.530	365.6	365.6	365.6	365.6	365.6	365.6	365.6	365.6	365.6	365.6	365.6	365.6	365.6	365.6	365.6	365.6	
32.000	406.272	2.661	1212.4	-173.07	0.550	367.5	19.7	6.705	367.5	367.5	367.5	367.5	367.5	367.5	367.5	367.5	367.5	367.5	367.5	367.5	367.5	367.5	367.5	367.5	
33.000	425.535	2.361	1202.0	-173.85	0.557	368.6	19.5	6.905	368.6	368.6	368.6	368.6	368.6	368.6	368.6	368.6	368.6	368.6	368.6	368.6	368.6	368.6	368.6	368.6	
34.000	445.073	2.025	1192.0	-174.20	0.557	369.2	19.5	7.110	369.2	369.2	369.2	369.2	369.2	369.2	369.2	369.2	369.2	369.2	369.2	369.2	369.2	369.2	369.2	369.2	
35.000	458.206	2.182	1182.2	-174.76	0.558	369.7	19.4	7.302	369.7	369.7	369.7	369.7	369.7	369.7	369.7	369.7	369.7	369.7	369.7	369.7	369.7	369.7	369.7	369.7	
36.000	475.535	2.013	1173.1	-175.25	0.553	369.6	19.4	7.489	369.6	369.6	369.6	369.6	369.6	369.6	369.6	369.6	369.6	369.6	369.6	369.6	369.6	369.6	369.6	369.6	
37.000	492.683	2.029	1164.1	-175.75	0.552	370.6	19.4	7.613	370.6	370.6	370.6	370.6	370.6	370.6	370.6	370.6	370.6	370.6	370.6	370.6	370.6	370.6	370.6	370.6	
38.000	511.216	2.126	1155.8	-176.23	0.549	371.5	19.3	7.813	371.5	371.5	371.5	371.5	371.5	371.5	371.5	371.5	371.5	371.5	371.5	371.5	371.5	371.5	371.5	371.5	
39.000	531.261	1.996	1147.0	-176.89	0.553	371.5	19.3	8.013	371.5	371.5	371.5	371.5	371.5	371.5	371.5	371.5	371.5	371.5	371.5	371.5	371.5	371.5	371.5	371.5	
40.000	546.507	1.837	1138.0	-177.18	0.549	372.1	19.3	8.208	372.1	372.1	372.1	372.1	372.1	372.1	372.1	372.1	372.1	372.1	372.1	372.1	372.1	372.1	372.1	372.1	
41.000	561.607	1.781	1130.6	-177.58	0.547	372.6	19.3	8.400	372.6	372.6	372.6	372.6	372.6	372.6	372.6	372.6	372.6	372.6	372.6	372.6	372.6	372.6	372.6	372.6	
42.000	576.433	1.728	1123.1	-178.00	0.546	373.1	19.2	8.599	373.1	373.1	373.1	373.1	373.1	373.1	373.1	373.1	373.1	373.1	373.1	373.1	373.1	373.1	373.1	373.1	
43.000	591.000	1.676	1115.8	-178.37	0.547	373.7	19.2	8.793	373.7	373.7	373.7	373.7	373.7	373.7	373.7	373.7	373.7	373.7	373.7	373.7	373.7	373.7	373.7	373.7	
44.000	612.407	1.633	1108.6	-178.80	0.546	374.0	19.2	8.958	374.0	374.0	374.0	374.0	374.0	374.0	374.0	374.0	374.0	374.0	374.0	374.0	374.0	374.0	374.0	374.0	
45.000	629.223	1.589	1101.3	-179.19	0.543	374.6	19.2	9.138	374.6	374.6	374.6	374.6	374.6	374.6	374.6	374.6	374.6	374.6	374.6	374.6	374.6	374.6	374.6	374.6	
46.000	646.454	1.542	1094.4	-179.56	0.543	374.9	19.2	9.354	374.9	374.9	374.9	374.9	374.9	374.9	374.9	374.9	374.9	374.9	374.9	374.9	374.9	374.9	374.9	374.9	
47.000	664.557	1.496	1087.8	-179.93	0.542	375.5	19.1	9.576	375.5	375.5	375.5	375.5	375.5	375.5	375.5	375.5	375.5	375.5	375.5	375.5	375.5	375.5	375.5	375.	

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 O2 1.14 -3.08 68.
 LM2 20.4 H2 0.071 -1.887 32.

BULK DENSITY = .196 GM/CC
 MIXTURE RATIO = 2.125 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 709.03 EU/100GMS

CHAMBER	FROZEN EXPANSION												THROAT
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	164.3
TEMP, DEG K	1918.8	1607.8	1336.5	1101.5	944.7	901.0	732.5	592.7	477.9	384.7	308.9	245.5	1680.9
ENTHALPY (-)	36.50	80.93	118.04	148.75	168.55	173.98	194.55	211.22	224.70	235.54	244.26	251.48	70.65
CP	1.4574	1.3981	1.3347	1.2803	1.2451	1.2366	1.2041	1.1825	1.1685	1.1560	1.1448	1.1347	1.4127
IMPUL OPT		196.61	266.35	312.51	338.95	345.84	370.81	389.87	404.64	416.12	425.14	432.47	172.38
IMPUL VAC		308.84	335.21	360.88	377.20	381.59	397.92	410.74	420.85	428.81	435.11	440.26	306.20
EPSILON		1.023	1.398	2.186	3.196	3.599	6.076	10.414	18.018	31.411	54.977	95.654	1.000

	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	164.5
TEMP, DEG K	1918.8	1608.7	1337.3	1102.3	945.4	901.7	733.0	593.2	478.3	385.0	309.2	245.8	1682.3
ENTHALPY (-)	36.50	80.94	118.07	148.81	168.62	174.04	194.63	211.31	224.81	235.65	244.37	251.61	70.59
X BAR	15.874	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873
N	15.874	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873
CP	1.4691	1.3997	1.3349	1.2805	1.2451	1.2368	1.2044	1.1825	1.1683	1.1563	1.1445	1.1349	1.4157
IMPUL OPT		196.64	266.40	312.58	339.03	345.92	370.90	389.98	404.75	416.24	425.26	432.60	172.21
IMPUL VAC		308.90	335.29	360.97	377.30	381.69	398.02	410.85	420.97	428.93	435.24	440.39	306.27
EPSILON		1.023	1.398	2.186	3.196	3.599	6.077	10.415	18.020	31.414	54.985	95.674	1.000

	COMPOSITION SHIFTING (MOL/100 GM)												
52.10 H	.0027	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005
9.33 H ₂ O	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 H ₂	11.6217	11.6229	11.6230	11.6230	11.6230	11.6230	11.6230	11.6230	11.6230	11.6230	11.6230	11.6230	11.6228
-57.80 H ₂ O	4.2499	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500
59.56 O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 O ₂	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

SYSTEM LIQUID DINITROPROPYLENE										PC 300. PSIA										HEAT FORM										WT. 6/9									
COMPONENT										DENSITY										(KCAL/FORM.WT.)																			
LOR										1.14										-3.08										60.									
LMZ										0.071										-1.087										12.									
										C STAR = 7862.2 FT/SEC																													
EPSILON										I SEA										I AT										I VAC									
PC/P										I SEA										I AT										I VAC									
P 300.0										1.000										1.000										1.000									
DEG K										1918.8										136.30										1.457									
TEMP / 1000GH										184.29										172.4										133.6									
CP CAL/G										143.88										128.0										107.2									
CM DEL										185.55										125.0										135.1									
										178.55										122.9										151.7									
										187.47										121.5										162.4									
										194.11										119.1										173.9									
										199.32										117.7										184.4									
										203.55										119.2										181.2									
										207.09										118.7										185.22									
										210.09										118.2										187.0									
										212.71										118.1										191.5									
										215.01										117.8										194.1									
										217.06										117.6										196.3									
										218.89										117.4										198.3									
										220.55										117.3										200.5									
										222.04										117.1										201.8									
										223.42										117.0										203.3									
										224.68										116.8										204.6									
										225.85										116.7										205.9									
										226.93										116.6										207.0									
										227.94										116.5										208.1									
										228.89										116.4										209.1									
										229.77										116.3										210.1									
										230.71										116.2										210.9									
										231.39										116.1										211.8									
										232.13										116.0										212.6									
										232.83										115.9										213.3									
										233.50										115.8										214.0									
										234.11										115.7										214.7									
										234.69										115.6										215.4									
										235.24										115.5										216.0									
										235.77										115.4										216.7									
										236.27										115.3										217.3									
										236.74										115.2										217.8									
										237.17										115.1										218.3									
										237.58										115.0										218.7									
										237.96										114.9										219.1									
										238.30										114.8										219.5									
										238.61										114.7										219.8									
										238.89										114.6										220.1									
										239.15										114.5										220.4									
										239.39										114.4										220.7									
										239.55										114.3										221.0									
										239.71										114.2										221.3									
										239.85										114.1										221.6									
										239.98										114.0										221.9									
										240.10										113.9										222.2									
										240.20										113.8										222.5									
										240.30										113.7										222.8									
										240.39										113.6										223.1									
										240.47										113.5										223.4									
										240.54										113.4										223.7									
										240.60										113.3										224.0									
										240.65										113.2										224.3									
										240.70										113.1										224.6									
										240.74										113.0										224.9									
										240.78										112.9										225.2									
										240.81										112.8										225.5									
										240.84										112.7										225.8									
										240.87										112.6										226.1									
										240.90										112.5										226.4									
										240.92										112.4										226.7									
										240.94										112.3										227.0									
										240.96										112.2										227.3									
										240.98										112.1										227.6									
										241.00										112.0										227.9									
										241.02										111.9										228.2									
										241.04										111.8										228.5									
										241.06										111.7										228.8									
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										241.14										111.3										230.0									
										241.16										111.2										230.3									
										241.18										111.1										230.6									
										241.20										111.0										230.9									
										241.22										110.9										231.2									
										241.24										110.8										231.5									
										241.26										110.7										231.8									
										241.28										110.6										232.1									
										241.30										110.5										232.4									
										241.32										110.4										232.7									
										241.34										110.3										233.0									
										241.36										110.2										233.3									
										241.38										110.1										233.6									
										241.40										110.0										233.9									
										241.42										109.9										234.2									
										241.44										109.8										234.5									
										241.46										109.7										234.8									
										241.48										109.6										235.1									
										241.50										109.5										235.4									
										241.52										109.4										235.7									
										241.54										109.3										236.0									
										241.56										109.2										236.3									
										241.58										109.1										236.6									
										241.60										109.0										236.9									
										241.62										108.9										237.2									
										241.64										108.8										237.5									
										241.66										108.7										237.8									
										241.68										108.6										238.1									
										241.70										108.5										238.4									
										241.72										108.4										238.7									
										241.74										108.3										239.0									
										241.76										108.2										239.3									
										241.78										108.1										239.6									
										241.80										108.0										239.9									
										241.82										107.9										240.2									
										241.84										107.8										240.5									
										241.86										107.7										240.8									
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										241.90										107.5										241.4									
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										242.16										106.2										245.3									
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										242.22										105.9										246.2									
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										242.40										105.0										248.9									
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										242.46										104.7										249.8									
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										242.54										104.3										251.0									
										242.56										104.2										251.3									
										242.58										104.1										251.6									
										242.60										104.0										251.9									
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										242.70										103.5										253.4									
										242.72										103.4										253.7									
										242.74										103.3										254.0									
										242.76										103.2										254.3									
										242.78										103.1										254.6									
										242.80										103.0										254.9									
										242.82										102.9										255.2									
										242.84										102.8										255.5									
										242.86										102.7										255.8									
										242.88										102.6										256.1									
										242.90										102.5										256.4									
										242.92										102.4										256.7									
										242.94										102.3										257.0									
										242.96										102.2										257.3									
										242.98										102.1										257.6									
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										243.02										101.9										258.2									
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										243.14										101.3										260.0									
										243.16										101.2										260.3									
										243.18										101.1										260.6									
										243.20										101.0										260.9									
										243.22										100.9										261.2									
										243.24										100.8										261.5									
										243.26										100.7										261.8									
										243.28										100.6										262.1									
										243.30										100.5										262.4									
										243.32										100.4										262.7									
										243.34										100.3										263.0									
										243.36										100.2										263.3									
										243.38										100.1										263.6									
										243.40										100.0										263.9									
										243.42										99.9										264.2									
										243.44										99.8										264.5									
										243.46										99.7										264.8									
										243.48										99.6										265.1									
										243.50										99.5										265.4									
										243.52										99.4										265.7									
										243.54										99.3										266.0									
										243.56										99.2										266.3									
										243.58										99.1										266.6									
										243.60										99.0										266.9									
										243.62										98.9										267.2									
										243.64										98.8										267.5									
										243.66										98.7										267.8									
										243.68										98.6										268.1									
										243.70										98.5										268.4									
										243.72										98.4										268.7									
										243.74										98.3										269.0									
										243.76										98.2										269.3									
										243.78										98.1										269.6									
										243.80										98.0										269.9									
										243.82										97.9										270.2									
										243.84										97.8										270.5									
										243.86										97.7										270.8									
										243.88										97.6										271.1									
										243.90										97.5										271.4									
										243.92										97.4										271.7									
										243.94										97.3										272.0									
										243.96										97.2										272.3									
										243.98										97.1										272.6									
										244.00										97.0										272.9									
										244.																													

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 O2 1.14 -3.08 73.
 LH2 20.4 H2 0.071 -1.887 27.

BULK DENSITY = .225 GM/CC
 MIXTURE RATIO = 2.704 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 641.54 EU/100GMS

	CHAMBER											THROAT														
	FROZEN EXPANSION																									
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	165.8													
TEMP, DEG K	2299.8	1951.3	1644.7	1375.9	1192.9	1141.3	939.3	767.8	624.1	505.3	407.9	328.8	2037.5													
ENTHALPY (-)	32.30	77.56	115.83	147.98	168.98	174.77	196.91	215.06	229.86	241.86	251.57	259.36	66.52													
CP	1.3208	1.2735	1.2221	1.1672	1.1275	1.1165	1.0742	1.0421	1.0183	1.0028	.9904	.9800	1.2868													
IMPUL OPT	198.43	269.58	317.24	344.83	352.06	378.42	398.74	414.57	426.98	436.76	444.45	472.54														
IMPUL VAC	312.39	340.28	367.51	384.92	389.63	407.19	421.06	432.02	440.70	447.58	453.03	309.39														
EPSILON	1.025	1.416	2.242	3.306	3.732	6.364	10.994	19.142	33.511	58.894	103.880	1.000														
	SHIFTING EXPANSION																									
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	165.8													
TEMP, DEG K	2299.8	1959.5	1653.8	1384.3	1200.6	1148.7	945.8	773.3	628.8	509.2	411.1	331.5	2044.7													
ENTHALPY (-)	32.30	77.65	116.08	148.39	169.49	175.32	197.58	215.84	230.73	242.82	252.59	260.44	66.57													
X BAR	13.405	13.395	13.393	13.393	13.393	13.393	13.393	13.393	13.393	13.393	13.393	13.393	13.397													
CP	1.3954	1.2928	1.2262	1.1688	1.1289	1.1178	1.0755	1.0429	1.0185	1.0029	.9901	.9806	1.3150													
IMPUL OPT	198.62	269.98	317.79	345.48	352.74	379.20	399.60	415.49	427.96	437.78	445.51	172.67														
IMPUL VAC	312.87	340.91	368.23	385.72	390.44	408.07	422.01	433.01	441.73	448.65	454.12	309.82														
EPSILON	1.025	1.418	2.245	3.311	3.738	6.375	11.016	19.184	33.590	59.041	104.163	1.000														
	COMPOSITION SHIFTING (MOL/100 GM)																									
52.10 H	.0232	.0044	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0071													
9.33 H2O	.0020	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004													
.00 H2	8.8198	8.8283	8.8301	8.8303	8.8304	8.8304	8.8304	8.8304	8.8304	8.8304	8.8304	8.8304	8.8270													
-57.80 H2O	4.5605	4.5623	4.5625	4.5625	4.5625	4.5625	4.5625	4.5625	4.5625	4.5625	4.5625	4.5625	4.5621													
59.56 O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000													
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000													

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 O2 1.14 -3.08 80.
 LM2 20.4 H2 0.071 -1.887 20.

BULK DENSITY = .284 GM/CC
 MIXTURE RATIO = 4.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 537.79 EU/100GMS

	CHAMBER											THROAT
	FROZEN EXPANSION											
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100 168.1
TEMP, DEG K	2926.6	2525.0	2168.9	1853.1	1635.3	1573.2	1325.7	1107.9	918.5	755.9	618.3	503.3 2631.3
ENTHALPY (-)	26.42	69.94	107.42	139.53	160.91	166.87	190.02	209.44	225.60	238.96	249.92	258.86 58.54
CP	1.0976	1.0685	1.0351	.9970	.9658	.9566	.9123	.8715	.8355	.8072	.7852	.7698 1.0769
IMPUL OPT	194.57	265.45	313.68	342.05	349.56	377.26	399.02	416.27	430.01	440.95	449.68	167.15
IMPUL VAC	307.34	336.45	365.02	383.59	388.67	407.79	423.15	435.45	445.28	453.13	459.41	303.94
EPSILON	1.029	1.443	2.323	3.475	3.941	6.852	12.057	21.339	37.860	67.250	119.540	1.000
	SHIFTING EXPANSION											
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100 168.9
TEMP, DEG K	2926.6	2602.4	2279.7	1968.6	1745.9	1681.7	1424.7	1196.9	997.4	824.8	677.5	553.4 2694.0
ENTHALPY (-)	26.42	70.46	109.11	142.64	165.12	171.42	195.90	216.55	233.83	248.18	260.01	269.69 58.58
X BAR	10.051	9.976	9.938	9.924	9.921	9.921	9.921	9.921	9.921	9.921	9.921	9.921 9.994
N	10.051	9.976	9.938	9.924	9.921	9.921	9.921	9.921	9.921	9.921	9.921	9.921 9.994
CP	1.6359	1.3528	1.1534	1.0397	.9882	.9760	.9284	.8849	.8471	.8157	.7901	.7725 1.4254
IMPUL OPT	195.73	268.20	317.98	347.37	355.17	383.98	406.70	424.79	439.23	450.79	460.04	167.25
IMPUL VAC	310.40	341.23	371.09	390.48	395.79	415.80	431.94	444.93	455.34	463.68	470.36	306.42
EPSILON	1.033	1.465	2.373	3.559	4.040	7.050	12.452	22.125	39.405	70.230	125.190	1.000
	COMPOSITION SHIFTING (MOL/100 GM)											
52.10 H	.1930	.0890	.0298	.0067	.0016	.0009	.0001	.0000	.0000	.0000	.0000	.1139
9.33 H2O	.0640	.0218	.0049	.0007	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0307
.00 H2	4.8589	4.8875	4.9082	4.9176	4.9199	4.9202	4.9206	4.9206	4.9206	4.9206	4.9206	4.8798
-57.80 H2O	4.9333	4.9777	4.9950	4.9993	4.9999	4.9999	5.0000	5.0000	5.0000	5.0000	5.0000	4.9685
59.56 O	.0015	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004
.00 O2	.0006	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002

SYSTEM LIQUID BIPROPELLANT										PC 300, PSIA		HEAT FORM		WT. G/G	
COMPONENT										DENSITY		(KCAL/POUN.WT.)			
										G/CC					
										1/LB		-3.00		80.	
										0.071		-1.007		20.	

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 O2 1.14 -3.08 85.
 LH2 20.4 H2 0.071 -1.887 15.

BULK DENSITY = .350 GM/CC
 MIXTURE RATIO = 5.667 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 456.69 EU/100GMS

CHAMBER													THROAT	
	FROZEN EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	168.9	
TEMP, DEG K	3322.1	2892.5	2510.3	2169.8	1933.8	1866.3	1595.8	1355.0	1141.3	953.6	790.4	650.5	3008.7	
ENTHALPY (-)	22.22	60.97	94.65	123.82	143.46	148.98	170.56	188.95	204.51	217.56	228.42	237.40	50.58	
CP	.9117	.8919	.8695	.8434	.8206	.8135	.7810	.7457	.7109	.6787	.6525	.6308	.8975	
IMPUL OPT		183.60	251.02	297.31	324.77	332.08	359.24	380.86	398.23	412.24	423.55	432.66	157.06	
IMPUL VAC		290.48	318.86	346.82	365.17	370.21	389.37	404.99	417.67	427.93	436.21	442.86	287.02	
EPSILON		1.031	1.457	2.368	3.572	4.062	7.149	12.751	22.876	41.117	73.873	132.542	1.000	
	SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	172.5	
TEMP, DEG K	3322.1	3069.6	2821.2	2567.1	2363.6	2300.5	2026.0	1759.3	1513.1	1291.0	1092.8	917.6	3146.6	
ENTHALPY (-)	22.22	61.77	97.65	130.07	152.65	159.10	184.77	207.18	226.53	243.10	257.18	269.06	49.96	
X BAR	7.847	7.713	7.603	7.521	7.480	7.471	7.448	7.442	7.441	7.440	7.440	7.440	7.752	
N	7.847	7.713	7.603	7.521	7.480	7.471	7.448	7.442	7.441	7.440	7.440	7.440	7.752	
CP	2.4629	2.1034	1.7070	1.3362	1.1110	1.0561	.8918	.8107	.7651	.7272	.6940	.6621	2.2212	
IMPUL OPT		185.49	256.17	306.32	336.85	345.08	376.05	401.13	421.59	438.36	452.12	463.41	155.34	
IMPUL VAC		295.84	328.56	360.81	382.22	388.14	410.75	429.35	444.68	457.30	467.67	476.14	291.10	
EPSILON		1.041	1.521	2.549	3.923	4.485	8.048	14.578	26.562	48.540	88.713	161.844	1.000	
	COMPOSITION SHIFTING (MOL/100 GM)													
52.10 H	.3542	.2608	.1738	.0979	.0528	.0422	.0126	.0024	.0003	.0000	.0000	.0000	.2891	
9.33 H2O	.3403	.2229	.1261	.0564	.0240	.0176	.0034	.0004	.0000	.0000	.0000	.0000	.2572	
.00 H2	2.2081	2.1550	2.1229	2.1123	2.1148	2.1164	2.1234	2.1269	2.1278	2.1280	2.1280	2.1280	2.1694	
-57.80 H2O	4.8851	5.0436	5.1676	5.2511	5.2872	5.2941	5.3090	5.3121	5.3125	5.3125	5.3125	5.3125	4.9980	
59.56 O	.0315	.0160	.0063	.0016	.0004	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0201	
.00 O2	.0278	.0150	.0062	.0017	.0004	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0186	

WATER LIQUID PROPELLANT										PC 300. PSIA		DENSITY		HEAT FORM		WT. 8/8			
COMPOSITION										TEMP FORMULA		GM/CC		(-CAL/FORM.WT.)		BTU			
										DEG I		1.14		-3.08		15.			
										LOX LHZ		20.4 MZ		0.071		-1.887			
										GALLEN EXPANSION		C STAR = 7420.1 FT/SEC							
										CM CAL/ I GPT		DELVAC DELVAC		I SEA I		I AT I		I VAC I	
										CM DEG		/ VAC		LVL 10000		50000		LVL	
EPSILON	PC/P	P PSIA	TEMP DEG	ENTHALPY KCAL/1000G	CM CAL/ I GPT	DELVAC CM DEG	DELVAC / VAC	I SEA	I AT	I VAC	CF SEA	CF VAC	PC VAC	CF VAC	PC VAC	CF VAC	PC VAC	CF VAC	
1.000	1.770	300.000	3322.1	-22.22	2.463	155.3	130.0	.787	279.5	289.8	291.1	1.233	1.184	1.243	1.194	1.243	1.194	1.243	
2.000	1.819	168.075	3146.6	-49.96	2.221	155.3	130.0	.800	1.637	330.2	344.7	1.368	1.270	1.368	1.270	1.368	1.270	1.368	
3.000	1.869	106.882	2829.6	-135.55	1.830	314.0	43.8	2.320	323.7	334.0	353.9	1.557	1.402	1.557	1.402	1.557	1.402	1.557	
4.000	24.063	12.667	1874.1	-148.36	1.814	312.2	38.4	3.079	338.0			366.6							
5.000	33.405	9.372	1318.9	-151.93	1.791	351.6	32.3	4.645				371.2							
6.000	43.123	6.957	1675.3	-160.31	1.791	351.6	32.3	4.645				376.0							
7.000	53.249	5.354	1605.2	-169.82	1.782	350.3	30.4	5.393				379.5							
8.000	64.659	4.354	1566.4	-174.40	1.774	363.9	28.8	6.193				382.1							
9.000	76.400	3.362	1528.6	-178.28	1.768	368.2	27.5	7.028				384.1							
10.000	88.420	2.393	1452.1	-181.63	1.761	372.4	26.4	7.791				385.8							
11.000	100.621	2.081	1413.4	-184.57	1.755	375.8	25.5	8.554				386.7							
12.000	112.836	2.459	1378.7	-187.18	1.749	378.0	24.7	9.285				387.7							
13.000	125.378	2.293	1347.4	-189.51	1.744	381.5	24.0	10.014				388.4							
14.000	138.323	2.213	1318.9	-191.83	1.739	384.1	23.1	10.740				389.7							
15.000	153.627	1.953	1282.7	-193.56	1.736	386.1	22.7	11.630				390.0							
16.000	168.217	1.783	1248.7	-195.33	1.732	388.1	22.2	12.433				390.0							
17.000	183.021	1.639	1216.3	-196.96	1.728	389.4	21.7	13.227				411.6							
18.000	197.977	1.515	1185.4	-198.46	1.725	391.7	21.0	14.014				412.8							
19.000	213.030	1.400	1156.2	-199.87	1.722	393.1	20.8	14.777				413.9							
20.000	228.136	1.315	1128.0	-201.18	1.719	394.6	20.6	15.530				415.0							
21.000	243.262	1.233	1101.9	-202.40	1.716	395.9	20.1	16.264				416.0							
22.000	258.587	1.161	1076.8	-203.55	1.713	397.5	19.8	16.987				417.1							
23.000	273.711	1.090	1049.5	-204.64	1.711	398.9	19.4	17.704				418.2							
24.000	290.480	1.032	1025.0	-205.67	1.708	399.5	19.1	18.510				419.4							
25.000	307.929	.974	1111.3	-206.64	1.706	400.6	18.8	19.317				419.4							
26.000	325.932	.922	1087.2	-207.56	1.703	401.6	18.6	20.123				420.1							
27.000	343.159	.870	1063.5	-208.43	1.701	402.6	18.4	20.930				420.1							
28.000	361.086	.811	1041.7	-209.28	1.699	403.4	18.1	21.730				420.1							
29.000	379.186	.751	1021.3	-210.08	1.697	404.3	17.8	22.529				422.1							
30.000	397.435	.755	1001.3	-210.84	1.695	405.1	17.6	23.322				422.7							
31.000	415.800	.715	981.8	-211.57	1.694	405.8	17.4	24.110				423.0							
32.000	434.288	.681	963.7	-212.27	1.692	406.6	17.2	24.891				423.8							
33.000	452.851	.662	942.0	-212.94	1.690	407.3	17.0	25.665				424.3							
34.000	471.480	.646	921.6	-213.59	1.689	408.0	16.8	26.431				424.8							
35.000	490.180	.631	901.4	-214.21	1.687	408.7	16.6	27.190				425.0							
36.000	508.948	.616	881.5	-214.81	1.686	409.3	16.5	27.939				425.6							
37.000	527.622	.609	865.5	-215.39	1.686	409.9	16.3	28.680				426.2							
38.000	546.384	.609	847.3	-215.94	1.683	410.5	16.1	29.413				426.7							
39.000	565.135	.611	829.5	-216.48	1.681	411.1	16.0	30.137				427.1							
40.000	583.938	.618	811.8	-217.00	1.680	411.6	15.9	30.862				427.5							
41.000	602.725	.628	795.4	-217.51	1.679	412.2	15.7	31.589				427.9							
42.000	621.530	.641	779.7	-217.99	1.678	412.7	15.6	32.322				428.3							
43.000	640.369	.666	765.3	-218.47	1.676	413.2	15.4	33.057				428.6							
44.000	659.248	.691	752.0	-218.93	1.675	413.7	15.3	33.787				429.0							
45.000	678.026	.717	739.6	-219.37	1.674	414.1	15.2	34.509				429.3							
46.000	706.823	.743	727.5	-219.80	1.673	414.6	15.1	35.254				429.7							
47.000	725.586	.811	714.2	-220.22	1.672	415.0	14.9	36.019				430.0							
48.000	744.368	.837	701.8	-220.65	1.671	415.4	14.8	36.788				430.4							
49.000	763.186	.867	690.2	-221.03	1.670	415.9	14.7	37.596				430.6							
50.000	782.050	.897	679.6	-221.42	1.669	416.3	14.6	38.407				430.9							
3.972	20.414	14.996	1933.8	-133.46	.821	326.8	60.4	2.749	324.8	336.9	360.5	365.2	1.407	1.582					
SHIFTING EXPANSION										C STAR = 7596.1 FT/SEC									
										CM CAL/ I GPT		DELVAC DELVAC		I SEA I		I AT I		I VAC I	
										CM DEG		/ VAC		LVL 10000		50000		LVL	
EPSILON	PC/P	P PSIA	TEMP DEG	ENTHALPY KCAL/1000G	CM CAL/ I GPT	DELVAC CM DEG	DELVAC / VAC	I SEA	I AT	I VAC	CF SEA	CF VAC	PC VAC	CF VAC	PC VAC	CF VAC	PC VAC	CF VAC	
1.000	1.739	127.507	3146.6	-49.96	2.221	155.3	135.8	.787	279.5	283.0	289.8	291.1	1.233	1.184	1.243	1.194	1.243	1.194	
2.000	1.819	66.835	2878.9	-110.41	1.491	287.0	60.0	1.837	323.0	330.2	344.7	367.0	1.417	1.270	1.417	1.270	1.417	1.270	
3.000	1.869	21.355	1402.0	2394.5	-153.60	1.103	338.1	45.0	1.210	336.0	357.7	381.1							
4.000	20.617	14.402	2249.2	-166.17	1.017	351.4	41.3	1.942		352.2	386.0	392.7							
5.000	28.634	8.127	2163.2	-172.37	.961	361.4	38.4	2.746			391.9	400.0							
6.000	36.916	6.355	1900.9	-177.88	.913	368.3	35.9	3.589			396.3	405.9							
7.000	45.344	5.520	2028.8	-184.53	.893	375.8	34.6	4.298			399.8	410.5							
8.000	54.085	4.881	1974.8	-190.26	.871	381.2	33.3	5.127			402.4	414.6							
9.000	74.210	4.043	1926.5	-193.37	.855	385.9	32.1	7.946			406.4	418.0							
10.000	86.554	3.635	1884.5	-195.93	1.848	391.1	31.1	8.820			410.0	421.1							
12.000	95.009	3.158	1840.4	-200.72	.831	393.5	30.2	9.930			407.4	423.7							
13.000	105.492	2.846	1809.3	-203.12	.822	396.7	29.3	10.316			408.3	426.1							
14.000	115.948	2.587	1776.9	-205.76	.815	399.6	28.6	11.056			409.5	428.2							
15.000	126.488	2.360	1747.1	-208.17	.808	402.8	27.9	11.820			410.8	430.1							
16.000	138.776	2.162	1719.5	-210.38	.802	406.4	27.3	12.618			412.0	431.9							
17.000	150.893	1.988	1693.9	-212.43	.797	406.8	26.8	13.472			410.6	433.6							
18.000	163.210	1.838	1670.0	-214.33	.792	408.8	26.3	14.296			410.7	435.1							
19.000	175.749	1.708	1647.8	-216.10	.788	410.7	25.8	15.090			410.7	436.5							
20.000	188.263	1.594	1626.5	-217.78	.784	412.5	25.4	15.816			410.7	437.8							
21.000	200.924	1.493	1606.6	-219.31	.780	414.1	25.0	16.712			410.0	439.0							
22.000	213.631	1.400	1587.8	-220.78	.777	415.6	24.6	17.496			410.2	440.2							
23.000	226.380	1.325	1569.9	-222.16	.776	417.1	24.2	18.267			410.3	441.3							
24.000	239.091	1.261	1553.8	-223.49	.774	418.5	23.9	19.029			410.4	442.4							
25.000	251.809	1.191	1538.6	-224.71	.769	419.7	23.6	19.769			410.5	443.3							
26.000	264.508	1.134	1521.4	-225.89	.766	420.9	23.2	20.490			410.6	444.2							

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 O2 1.14 -3.08 90.
 LM2 20.4 H2 0.071 -1.887 10.

BULK DENSITY = .455 GM/CC
 MIXTURE RATIO = 9.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 368.96 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	167.9
TEMP, DEG K	3415.7	2984.7	2600.5	2257.8	2019.8	1951.6	1678.1	1434.1	1216.6	1024.0	855.0	708.4	3098.4
ENTHALPY (-)	18.02	48.20	74.52	97.41	112.88	117.25	134.35	149.01	161.50	172.06	180.90	188.27	40.30
CP	.7069	.6925	.6767	.6580	.6421	.6369	.6133	.5875	.5605	.5353	.5121	.4925	.6968
IMPUL OPT		162.03	221.70	262.80	287.28	293.81	318.12	337.58	353.30	366.07	376.43	384.85	139.22
IMPUL VAC		256.49	281.85	306.85	323.33	327.87	345.17	359.36	370.96	380.42	388.08	394.29	253.34
EPSILON		1.032	1.463	2.386	3.609	4.108	7.265	13.030	23.522	42.551	76.939	138.866	1.000
	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	173.8
TEMP, DEG K	3415.7	3193.3	2988.4	2796.5	2655.3	2613.1	2432.8	2249.1	2054.2	1843.8	1625.2	1413.5	3262.0
ENTHALPY (-)	18.02	48.89	77.19	103.18	121.71	127.09	149.06	169.18	187.51	204.00	218.62	231.41	39.35
X BAR	5.932	5.812	5.702	5.601	5.531	5.512	5.435	5.372	5.329	5.305	5.295	5.293	5.849
N	5.932	5.812	5.702	5.601	5.531	5.512	5.435	5.372	5.329	5.305	5.295	5.293	5.849
CP	2.5806	2.4567	2.2820	2.0646	1.8656	1.8014	1.5084	1.2063	.9337	.7393	.6342	.5828	2.5013
IMPUL OPT		163.87	226.88	272.19	300.34	308.04	337.63	362.64	383.99	402.24	417.75	430.86	136.22
IMPUL VAC		261.78	291.81	321.94	342.62	348.46	371.49	391.44	408.63	423.26	435.56	445.87	257.31
EPSILON		1.043	1.541	2.629	4.130	4.757	8.873	16.814	32.033	60.850	114.811	215.509	1.000
	COMPOSITION SHIFTING (MOL/100 GM)												
52.10 H	.1893	.1453	.1067	.0737	.0522	.0465	.0255	.0112	.0034	.0006	.0000	.0000	.1587
9.33 H2O	.6611	.5482	.4435	.3477	.2800	.2606	.1831	.1161	.0622	.0257	.0076	.0015	.5832
.00 H2	.5275	.4412	.3572	.2763	.2173	.2001	.1309	.0727	.0308	.0086	.0014	.0001	.4685
-57.80 H2O	4.0076	4.1725	4.3281	4.4733	4.5769	4.6067	4.7251	4.8240	4.8967	4.9385	4.9551	4.9594	4.1209
59.56 O	.1360	.1055	.0791	.0566	.0419	.0379	.0230	.0119	.0048	.0013	.0002	.0000	.1147
.00 O2	.4102	.3994	.3872	.3737	.3631	.3599	.3469	.3365	.3306	.3297	.3311	.3320	.4031

SYSTEM LIQUID PROPELLANT		PC 300, PSIA		HEAT FORM		WT. O/S	
COMPONENT	TREF FORMULA	DENSITY	GM/CC	IKCAL/FORM.WT.	IKCAL/FORM.WT.	90.	10.
LOR	90.2 OZ	1.14	0.71	-1.887	90.		
LHZ	20.4 HZ	0.71	-1.887	10.			
FROZEN EXPANSION							
C STAR = 4561.4 FT/SEC							
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/ I OPT DELVAC DELVAC	I SEA	I AT
			DEG K	KCAL/1000M	GM DEG	LVL	10000
							50000
							I VAC
							CF SEA CF VAC
							LVL
1.000	1.000	100.000	3415.7	-18.02	2.501	247.1	250.2
2.000	1.787	107.888	3098.4	-40.30	2.697	243.4	246.4
3.000	8.961	33.477	2364.9	-90.34	2.865	243.4	246.4
4.000	15.678	19.135	2121.7	-106.31	2.869	243.4	246.4
5.000	21.679	12.649	1965.4	-116.36	2.869	243.4	246.4
6.000	32.653	9.187	1852.7	-121.51	2.869	243.4	246.4
7.000	42.262	7.093	1765.4	-128.96	2.869	243.4	246.4
8.000	52.136	5.756	1694.8	-133.33	2.869	243.4	246.4
9.000	62.904	4.769	1635.6	-136.95	2.869	243.4	246.4
10.000	74.370	4.034	1584.8	-140.03	2.869	243.4	246.4
11.000	86.115	3.484	1540.6	-142.69	2.869	243.4	246.4
12.000	97.975	3.062	1501.5	-145.02	2.869	243.4	246.4
13.000	109.831	2.731	1466.6	-147.10	2.869	243.4	246.4
14.000	121.622	2.467	1435.0	-148.96	2.869	243.4	246.4
15.000	134.970	2.223	1406.2	-150.65	2.869	243.4	246.4
16.000	148.710	2.017	1379.7	-152.19	2.869	243.4	246.4
17.000	162.728	1.844	1355.4	-153.60	2.869	243.4	246.4
18.000	176.940	1.695	1332.8	-154.90	2.869	243.4	246.4
19.000	191.346	1.568	1311.7	-156.11	2.869	243.4	246.4
20.000	205.832	1.457	1292.1	-157.23	2.869	243.4	246.4
21.000	220.376	1.361	1273.6	-158.28	2.869	243.4	246.4
22.000	234.941	1.277	1256.3	-159.27	2.869	243.4	246.4
23.000	249.505	1.202	1239.9	-160.19	2.869	243.4	246.4
24.000	264.053	1.136	1224.4	-161.07	2.869	243.4	246.4
25.000	278.540	1.076	1209.7	-161.89	2.869	243.4	246.4
26.000	292.974	1.016	1195.7	-162.67	2.869	243.4	246.4
27.000	307.325	0.961	1182.4	-163.42	2.869	243.4	246.4
28.000	321.633	0.911	1169.6	-164.12	2.869	243.4	246.4
29.000	335.833	0.866	1157.4	-164.80	2.869	243.4	246.4
30.000	349.933	0.825	1145.8	-165.46	2.869	243.4	246.4
31.000	363.933	0.787	1134.8	-166.10	2.869	243.4	246.4
32.000	377.833	0.753	1124.3	-166.65	2.869	243.4	246.4
33.000	391.633	0.721	1114.3	-167.21	2.869	243.4	246.4
34.000	405.333	0.691	1104.8	-167.76	2.869	243.4	246.4
35.000	418.933	0.666	1096.1	-168.28	2.869	243.4	246.4
36.000	432.433	0.643	1088.0	-168.78	2.869	243.4	246.4
37.000	445.833	0.621	1080.5	-169.27	2.869	243.4	246.4
38.000	459.133	0.600	1073.5	-169.73	2.869	243.4	246.4
39.000	472.333	0.579	1067.3	-170.18	2.869	243.4	246.4
40.000	485.433	0.559	1061.9	-170.61	2.869	243.4	246.4
41.000	498.433	0.539	1057.0	-171.04	2.869	243.4	246.4
42.000	511.333	0.520	1052.4	-171.45	2.869	243.4	246.4
43.000	524.133	0.504	1048.0	-171.85	2.869	243.4	246.4
44.000	536.833	0.489	1043.8	-172.23	2.869	243.4	246.4
45.000	549.433	0.474	1039.8	-172.60	2.869	243.4	246.4
46.000	561.933	0.460	1035.9	-172.96	2.869	243.4	246.4
47.000	574.333	0.445	1032.1	-173.31	2.869	243.4	246.4
48.000	586.633	0.432	1028.4	-173.66	2.869	243.4	246.4
49.000	598.833	0.419	1024.8	-173.99	2.869	243.4	246.4
50.000	610.933	0.407	1021.3	-174.31	2.869	243.4	246.4
51.000	622.933	0.396	1017.7	-174.63	2.869	243.4	246.4
52.000	634.833	0.386	1014.2	-174.94	2.869	243.4	246.4
53.000	646.633	0.376	1010.8	-175.24	2.869	243.4	246.4
54.000	658.333	0.366	1007.4	-175.54	2.869	243.4	246.4
55.000	669.933	0.356	1004.1	-175.83	2.869	243.4	246.4
56.000	681.433	0.346	1000.8	-176.12	2.869	243.4	246.4
57.000	692.833	0.336	997.4	-176.41	2.869	243.4	246.4
58.000	704.133	0.326	994.1	-176.69	2.869	243.4	246.4
59.000	715.333	0.316	990.8	-176.97	2.869	243.4	246.4
60.000	726.433	0.306	987.4	-177.25	2.869	243.4	246.4
61.000	737.433	0.296	984.1	-177.53	2.869	243.4	246.4
62.000	748.333	0.286	980.8	-177.81	2.869	243.4	246.4
63.000	759.133	0.276	977.4	-178.09	2.869	243.4	246.4
64.000	769.833	0.266	974.1	-178.37	2.869	243.4	246.4
65.000	780.433	0.256	970.8	-178.65	2.869	243.4	246.4
66.000	790.933	0.246	967.4	-178.93	2.869	243.4	246.4
67.000	801.333	0.236	964.1	-179.21	2.869	243.4	246.4
68.000	811.633	0.226	960.8	-179.49	2.869	243.4	246.4
69.000	821.833	0.216	957.4	-179.77	2.869	243.4	246.4
70.000	831.933	0.206	954.1	-180.05	2.869	243.4	246.4
71.000	841.933	0.196	950.8	-180.33	2.869	243.4	246.4
72.000	851.833	0.186	947.4	-180.61	2.869	243.4	246.4
73.000	861.633	0.176	944.1	-180.89	2.869	243.4	246.4
74.000	871.333	0.166	940.8	-181.17	2.869	243.4	246.4
75.000	880.933	0.156	937.4	-181.45	2.869	243.4	246.4
76.000	890.433	0.146	934.1	-181.73	2.869	243.4	246.4
77.000	900.033	0.136	930.8	-182.01	2.869	243.4	246.4
78.000	909.433	0.126	927.4	-182.29	2.869	243.4	246.4
79.000	918.733	0.116	924.1	-182.57	2.869	243.4	246.4
80.000	927.933	0.106	920.8	-182.85	2.869	243.4	246.4
81.000	937.033	0.096	917.4	-183.13	2.869	243.4	246.4
82.000	946.033	0.086	914.1	-183.41	2.869	243.4	246.4
83.000	954.933	0.076	910.8	-183.69	2.869	243.4	246.4
84.000	963.733	0.066	907.4	-183.97	2.869	243.4	246.4
85.000	972.433	0.056	904.1	-184.25	2.869	243.4	246.4
86.000	981.033	0.046	900.8	-184.53	2.869	243.4	246.4
87.000	989.533	0.036	897.4	-184.81	2.869	243.4	246.4
88.000	997.933	0.026	894.1	-185.09	2.869	243.4	246.4
89.000	1006.233	0.016	890.8	-185.37	2.869	243.4	246.4
90.000	1014.433	0.006	887.4	-185.65	2.869	243.4	246.4

SHIFTING EXPANSION												
C STAR = 4723.7 FT/SEC												
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DELVAC	DELVAC	I SEA	I AT	I AT	I VAC
			DEG K	KCAL/1000M	GM DEG	LVL	LVL	LVL	10000	50000	CF SEA	CF VAC
											LVL	LVL
1.000	1.000	300.000	3415.0	-2.50	2.501	136.2	121.1	1.447	247.1	250.2	256.1	1.231
2.000	7.926	173.829	3262.0	-30.35	2.501	136.2	121.1	1.447	247.1	250.2	256.1	1.231
3.000	17.331	37.827	2886.4	-51.11	2.175	252.9	54.8	1.699	286.4	292.8	305.2	1.077
4.000	18.335	22.497	2753.9	-58.85	2.008	281.1	47.2	2.099	297.5	306.8	324.8	1.424
5.000	19.588	15.316	2664.9	-70.47	1.880	268.5	42.7	2.789	301.5	312.6	336.5	1.437
6.000	26.269	11.420	2598.4	-78.95	1.779	270.7	39.0	3.485	314.7	326.8	350.5	1.077
7.000	33.411	8.974	2545.1	-85.59	1.694	319.8	37.7	4.198		350.4	357.5	1.711
8.000	40.798	7.353	2500.6	-91.02	1.621	327.1	36.1	4.907		354.8	363.2	1.738
9.000	48.266	6.216	2462.4	-95.59	1.558	333.1	34.6	5.598		358.4	367.9	1.761
10.000	55.807	5.376	2428.7	-99.51	1.495	341.2	33.1	6.289		361.3	371.9	1.784
11.000	63.405	4.681	2398.4	-102.99	1.451	347.7	32.8	7.007		363.5	375.5	1.797
12.000	71.039	4.136	2371.4	-106.07	1.405	354.6	32.6	7.739		365.4	378.5	1.812
13.000	78.692	3.699	2346.5	-108.83	1.364	350.0	31.3	8.462		366.9	381.3	1.825
14.000	86.367	3.345	2323.5	-111.34	1.326	353.1	30.7	9.171		368.2	384.2	1.837
15.000	94.041	3.054	2302.2	-113.63	1.291	356.2	29.9	9.862		369.2	386.8	1.849
16.000	101.749	2.810	2282.3	-115.74	1.259	358.5	29.6	10.538		370.1	388.1	1.857
17.000	109.479	2.605	2263.5	-117.70	1.229	360.9	29.2	11.193		370.9	390.0	1.866
18.000	117.223	2.425	2245.8	-119.51	1.201	363.0	28.7	11.848		371.5	391.8	1.875
19.000	125.000	2.252	2229.0	-121.21	1.175	365.2	28.3	12.493		371.9	393.4	1.884
20.000	132.783	2.101	2213.0	-122.80	1.151	367.0	28.0	13.106		372.2	394.9	1.890
21.000	140.540	1.967	2197.8	-124.30	1.128	368.7	27.6	14.034		372.4	396.3	1.897
22.000	148.266	1.849	2183.3	-125.72	1.106	370.4	27.3	14.840		372.5	397.6	1.903
23.000	155.950	1.743	2169.3	-127.05	1.086	372.0	27.0	15.642		372.5	398.7	1.909
24.000	163.592	1.648	2156.0	-128.32	1.067	373.4	26.7	16.434		372.5	399.7	1.914
25.000	171.195	1.562	2143.1	-129.53	1.049	374.9	26.4	16.908		401.3		1.920
26.000	178.764	1.485	2130.7	-130.68	1.032	376.2	26.2	17.611		402.3		1.925
27.000	186.296	1.416	2118.7	-131.78	1.016	377.5	25.9	18.306		403.4		1.930
28.000	193.780	1.352	2107.2	-132.83	1.000	378.9	25.7	18.991		404.4		1.935
29.000	201.218	1.294	2096.0	-133.84	0.986	380.3	25.5	19.670		405.4		1.940
30.000	208.612	1.241	2085.1	-134.80	0.972	380.9	25.3	20.339		406.2		1.944
31.000	215.960	1.192	2074.4	-135.73	0.959	382.0	25.0	20.989		407.0		1.948
32.000	223.269	1.147	2064.4	-136.62	0.946	383.0	24.8	21.630		407.8		1.952
33.000	230.530	1.106	2054.5	-137.48	0.934	384.2	24.6	22.262		408.5		1.956
34.000	237.742	1.068	2044.7	-138.31	0.923	384.1	24.5	23.014		409.4		1.959
35.000	244.944	1.033	2035.2	-139.11	0.912	385.6	24.3	23.740		410.1		1.962
36.000	252.146	0.998	2025.0	-139.89	0.902	386.7	24.1	24.467		410.8		1.966
37.000	259.348	0.969	2014.9	-140.65	0.892	387.5	23.9	25.187		411.5		1.969
38.000	266.550	0.940	2004.8	-141.40	0.883	388.3	23.8	25.919		412.1		1.972
39.000	273.752	0.912	1994.5	-142.07	0.874	389.1	23.6	26.643		412.8		1.975
40.000	280.954	0.884	1984.1	-142.75	0.865	389.9	23.5	27.367		413.4		1.978
41.000	288.156	0.856	1973.9	-143.41	0.857	390.6	23.3	28.089		414.0		1.981
42.000	295.358	0.828	1963.6	-144.05	0.849	391.3	23.2	28.809		414.5		1.984
43.000	302.560	0.801	1953.0	-144.68	0.842	392.0	23.1	29.527		415.1		1.986
44.000	309.762	0.773	1942.3	-145.29	0.834	392.7	22.9	30.243		415.6		1.989
45.000	316.964	0.745	1931.8	-145.88	0.827	393.4	22.8	30.955		416.2		1.991
46.000	324.166	0.718	1921.3	-146.45	0.819	394.1	22.7	31.667		416.7		1.994
47.000	331.368	0.690	1910.7	-147.01	0.814	394.6	22.5	32.371		417.2		1.996
48.000	338.570	0.663	1900.1	-147.57	0.808	395.2	22.4	33.073		417.7		1.999
49.000	345.772	0.635	1889.5	-148.11	0.801	395.8	22.3	33.772		418.1		2.001
50.000	352.974	0.608	1878.9	-148.63	0.796	396.4	22.2	34.468		418.6		2.003
51.000	360.176	0.580	1868.3	-149.14	0.790	397.0	22.1	35.158		419.0		2.005
52.000	367.378	0.553	1857.7	-149.63	0.784	397.5	22.0	35.847	309.3	313.1	337.7	1.437
53.000	374.580	0.525	1847.1	-150.11	0.778	398.0	21.9	36.537		342.6		1.439

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O₂ - RP - 1 SYSTEM

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. 0/0
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 02 1.14 -3.08 60.
 RP-1 298 C+H1.953 0.80 -6.92 40.

BULK DENSITY = .974 GM/CC
 MIXTURE RATIO = 1.500 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 293.42 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	548.2
TEMP, DEG K	2449.2	2009.4	1638.4	1325.9	1063.7	931.9	845.8	666.7	521.6	405.9	314.8	241.0	2153.9
ENTHALPY (-)	25.58	48.61	67.45	82.75	95.09	101.10	104.95	112.75	118.88	123.66	127.37	130.34	41.12
CP	.5309	.5161	.4986	.4796	.4612	.4504	.4434	.4280	.4171	.4093	.4042	.4008	.5212
IMPUL OPT	141.56	190.86	223.03	245.91	256.32	262.77	275.39	284.90	292.11	297.58	301.89	301.89	116.27
IMPUL VAC	211.01	232.86	252.12	267.08	274.11	278.52	287.23	293.86	298.91	302.75	305.79	306.91	
EPSILON	1.055	1.603	2.788	5.096	7.321	9.526	17.996	34.185	65.169	124.633	236.207	1.000	
	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	549.6
TEMP, DEG K	2449.2	2020.5	1656.1	1354.4	1120.6	1029.4	981.2	915.2	861.5	813.6	770.1	729.8	2163.5
ENTHALPY (-)	25.58	48.67	67.64	83.17	95.89	102.29	106.56	115.97	124.55	132.43	139.69	146.40	41.08
X BAR	5.660	5.656	5.656	5.654	5.631	5.576	5.518	5.359	5.211	5.074	4.947	4.829	5.657
N	5.660	5.656	5.656	5.654	5.631	5.576	5.518	5.359	5.211	5.074	4.947	4.829	5.657
CP	.5572	.5283	.5159	.5202	.4853	1.1041	1.5308	4.5701	4.8153	4.8552	4.7081	4.4067	.5356
IMPUL OPT	141.74	191.30	223.83	247.32	258.34	265.42	280.42	293.44	304.89	315.08	324.21	324.21	116.14
IMPUL VAC	211.44	233.63	253.41	269.38	277.55	283.06	295.54	306.66	316.60	325.53	333.60	333.60	207.24
EPSILON	1.056	1.611	2.828	5.297	7.885	10.639	22.912	50.339	111.909	251.029	566.930	1.000	
	COMPOSITION SHIFTING (MOL/100 GM)												
170.89 C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
142.00 C+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-2.90 C+H+O	.0006	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
67.00 C+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-27.70 C+H2+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
31.94 C+H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-17.89 C+H4	.0000	.0000	.0001	.0009	.0125	.0400	.0688	.0682	.0577	.0487	.0413	.0355	.0000
-26.42 C+O	2.7005	2.6688	2.6170	2.5350	2.4063	2.3005	2.2150	1.9135	1.6163	1.3386	1.0810	.8442	2.6818
-94.05 C+O2	.1603	.1925	.2444	.3256	.4428	.5210	.5777	.7194	.8577	.9894	1.1128	1.2261	.1794
199.00 C2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
112.10 C2+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
54.19 C2+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
12.50 C2+H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
189.70 C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
242.30 C4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.0083	.0012	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0026
9.33 H+O	.0006	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
.00 H2	2.0619	2.0975	2.1498	2.2287	2.3112	2.3067	2.2770	2.2602	2.2605	2.2642	2.2682	2.2696	2.0838
-57.80 H2+O	.7276	.6960	.6442	.5637	.4582	.4075	.3796	.3976	.4183	.4327	.4434	.4536	.7089
59.56 O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 C/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.1604	.3299	.4849	.6264	.7557	.0000

		SYSTEM LIQUID NITROGEN				PC 1000, PSIA				HEAT FORM				WT. O/O			
		COMPONENT		THER FORMULA		DENSITY		G/CC		(KCAL/FORM.WT.)							
		DEG R		90.2 82		1.14		-3.00									
		LX		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									
		LX-1		288		0.80		-0.92									

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/S
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 02 1.14 -3.08 65.
 RP-1 298 C₈H₁₈ 0.80 -6.92 35.

BULK DENSITY = .992 GM/CC
 MIXTURE RATIO = 1.857 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 286.27 EU/100GMS

CHAMBER	FROZEN EXPANSION												THROAT
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	554.4
TEMP, DEG K	3126.8	2614.2	2176.5	1802.5	1483.2	1319.4	1210.9	980.0	785.8	624.4	492.1	385.7	2789.4
ENTHALPY (-)	23.58	49.77	71.62	89.78	104.76	112.21	117.05	127.03	135.08	141.51	146.59	150.58	40.88
CP	.5159	.5051	.4924	.4775	.4605	.4493	.4416	.4229	.4056	.3904	.3789	.3706	.5095
IMPUL OPT	150.95	204.43	239.97	265.75	277.67	285.15	300.00	311.45	320.29	327.13	332.39	332.39	222.69
INPUL VAC	225.75	250.42	272.41	289.86	298.20	303.49	314.11	322.34	328.71	333.63	337.40	337.40	220.89
EPSILON	1.061	1.638	2.903	5.418	7.885	10.356	20.010	38.820	75.341	146.052	282.930	1.000	
SHIFTING EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	559.7
TEMP, DEG K	3126.8	2686.6	2272.0	1901.3	1584.0	1423.8	1319.2	1102.9	931.1	816.9	767.6	728.2	2847.1
ENTHALPY (-)	23.58	50.06	72.53	91.40	107.14	115.06	120.25	131.19	140.36	148.19	155.18	161.64	40.76
X BAR	4.996	4.965	4.952	4.949	4.949	4.949	4.949	4.949	4.944	4.892	4.775	4.660	4.974
N	4.996	4.965	4.952	4.949	4.949	4.949	4.949	4.949	4.944	4.892	4.883	4.892	4.974
CP	.6970	.5872	.5254	.5007	.4941	.4954	.4981	.5162	.5862	1.2259	4.7218	4.3974	.6222
IMPUL OPT	151.77	206.35	242.89	269.61	282.11	290.00	305.96	318.74	329.25	338.35	346.55	355.02	222.39
INPUL VAC	227.75	253.49	276.39	294.75	303.70	309.46	321.38	331.23	339.74	347.72	355.02	355.02	222.39
EPSILON	1.067	1.663	2.967	5.593	8.213	10.879	21.653	44.039	92.962	208.391	473.150	1.000	
COMPOSITION SHIFTING (MOL/100 GM)													
170.89 C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
142.00 C ₂ H ₄	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-2.90 C ₂ H ₆ O	.0010	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005
67.00 C ₂ H ₂	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-27.70 C ₂ H ₂ O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
31.94 C ₂ H ₃	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-17.89 C ₂ H ₄	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	.0023	.0283	.0331	.0282	.0000
-26.42 C ₂ O	2.1955	2.1701	2.1324	2.0754	1.9919	1.9281	1.8747	1.7195	1.5328	1.3309	1.0890	.8552	2.1804
-94.05 C ₂ O ₂	.3073	.3334	.3713	.4284	.5119	.5757	.6292	.7842	.9687	1.1446	1.2738	1.3880	.3229
199.00 C ₂	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
112.10 C ₂ H ₄	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
54.19 C ₂ H ₂	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
12.50 C ₂ H ₄	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
189.70 C ₃	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
242.30 C ₄	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.0671	.0253	.0063	.0010	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0379
9.33 H ₂ O	.0266	.0067	.0010	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0118
.00 F ₂	1.1744	1.2104	1.2548	1.3143	1.3982	1.4620	1.5154	1.6702	1.8483	1.9460	1.9528	1.9572	1.1963
-57.80 F ₂ O	1.2232	1.2184	1.1864	1.1302	1.0467	.9830	.9295	.7746	.5922	.4423	.4259	.4313	1.2236
59.56 O	.0009	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
.00 O ₂	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
.00 C/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.1079	.2324	.0000

[illegible]

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. 0/0
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 02 1.14 -3.08 68.
 RP-1 298 C₈H₁₈ 0.80 -6.92 32.

BULK DENSITY = 1.004 GM/CC
 MIXTURE RATIO = 2.125 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 279.74 EU/100GMS

CHAMBER													THROAT
	FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	557.1
TEMP, DEG K	3440.0	2900.8	2437.7	2039.8	1697.7	1521.3	1404.0	1151.9	936.8	754.9	602.8	477.2	3088.1
ENTHALPY (-)	22.39	49.30	71.96	90.97	106.83	114.79	119.99	130.83	139.69	146.87	152.62	157.20	40.01
CP	.5035	.4942	.4836	.4711	.4559	.4465	.4391	.4208	.4025	.3857	.3708	.3590	.4979
IMPUL OPT		153.03	207.67	244.26	271.04	283.53	291.39	307.15	319.46	329.08	336.60	342.47	123.82
IMPUL VAC		229.20	254.84	277.81	296.21	305.09	310.75	322.22	331.24	338.30	343.79	348.07	224.04
EPSILON		1.064	1.654	2.956	5.570	8.156	10.763	21.042	41.332	81.209	159.246	311.262	1.000

	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	568.3
TEMP, DEG K	3440.0	3054.3	2668.3	2289.0	1938.8	1755.1	1633.1	1374.4	1159.8	984.8	843.6	737.8	3202.9
ENTHALPY (-)	22.39	49.81	73.72	94.28	111.78	120.67	126.53	138.96	149.42	158.28	165.82	172.33	39.65
X BAR	4.648	4.584	4.546	4.530	4.526	4.525	4.525	4.525	4.525	4.525	4.524	4.503	4.606
N	4.648	4.584	4.546	4.530	4.526	4.525	4.525	4.525	4.525	4.525	4.524	4.503	4.606
CP	.9503	.7589	.6071	.5227	.4891	.4819	.4800	.4820	.4952	.5191	.5596	.8824	.8309
IMPUL OPT		154.47	211.31	250.10	278.86	292.41	301.00	318.45	332.44	343.83	353.25	361.17	122.55
IMPUL VAC		232.83	260.94	285.94	306.07	315.89	322.23	335.33	346.08	355.03	362.59	369.13	226.62
EPSILON		1.075	1.710	3.102	5.913	8.724	11.588	23.156	47.014	96.955	203.027	434.219	1.000

COMPOSITION SHIFTING (MOL/100 GM)													
170.89 C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
142.00 C#H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-2.90 C#H#C	.0010	.0004	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0006
67.00 C#H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-27.70 C#H2#O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
31.94 C#H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-17.89 C#H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-26.42 C#O	1.8451	1.8129	1.7814	1.7418	1.6848	1.6413	1.6043	1.4944	1.3514	1.1777	.9836	.7885	1.8249
-94.05 C#O2	.4431	.4759	.5077	.5473	.6044	.6480	.6849	.7948	.9378	1.1115	1.3051	1.4899	.4637
199.00 C2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
112.10 C2#H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
54.19 C2#H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
12.50 C2#H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
189.70 C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
242.30 C4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.1146	.0658	.0287	.0085	.0016	.0005	.0002	.0000	.0000	.0000	.0000	.0000	.0037
9.33 H#O	.1015	.0456	.0137	.0024	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0646
.00 H2	.7334	.7463	.7755	.8189	.8783	.9223	.9595	1.0694	1.2124	1.3860	1.5783	1.7323	.7394
-57.80 H2#O	1.3934	1.4332	1.4386	1.4110	1.3562	1.3128	1.2758	1.1660	1.0230	.8493	.6562	.4816	1.4216
59.56 O	.0091	.0024	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0043
.00 O2	.0068	.0018	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0033

SYSTEM LIQUID BIPROPELLANT										PC 1000, PSIA		HEAT FORM		WT. G/G	
COMPONENT		TREF FORMULA		DENSITY		GM/C		IN/KAL/FORM.WT.1		69.		32.			
LOX		90.2 02		1.14		-9.08		0.00		0.00		0.00		0.00	
RP-1		90.2 02		1.14		-9.08		0.00		0.00		0.00		0.00	
PROZEN EXPANSION															
C STAR = 5787.9 FT/SEC															
EPSILON	PC/F	P PSIA	TEMP	ENTHALPY	CP CAL/G	I OPT	DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC	
				DEG K	GM DEG		/P	/P	LVL	10000	50000	LVL	LVL		
1.000	1.000	1000.000	3440.0	-40.01	-40.01	498	123.8	100.2	1.180	221.4	222.2	223.7	224.0	1.231	1.245
2.000	1.755	557.093	3088.1	-70.18	-70.18	479	222.8	40.6	1.376	257.9	259.6	262.8	263.4	1.434	1.444
3.000	9.266	107.624	2288.0	-91.38	-91.38	471	249.0	38.5	1.940	270.4	272.8	277.4	278.3	1.503	1.547
4.000	25.414	39.368	1847.0	-60.05	-60.05	464	258.3	29.0	1.736	276.5	279.7	286.0	287.1	1.537	1.597
5.000	34.683	28.833	1751.0	-104.40	-104.40	459	267.1	26.3	1.912	280.0	284.1	291.9	293.4	1.557	1.631
6.000	44.330	22.558	1641.8	-108.47	-108.47	454	273.7	24.4	1.082	282.2	286.9	296.2	298.1	1.568	1.657
7.000	55.153	18.132	1589.7	-111.72	-111.72	450	278.8	22.9	1.264	283.1	288.7	299.5	301.7	1.574	1.677
8.000	66.285	15.086	1529.8	-114.41	-114.41	447	282.9	21.7	1.440	283.5	289.9	302.2	304.7	1.576	1.694
9.000	78.144	12.787	1478.8	-116.89	-116.89	444	286.4	20.7	1.621	283.5	290.5	304.4	307.2	1.578	1.708
10.000	90.444	11.056	1434.2	-118.86	-118.86	441	289.4	19.9	1.801	283.5	290.8	308.2	309.3	1.579	1.719
11.000	103.129	9.697	1395.1	-120.38	-120.38	439	292.0	19.2	1.980	283.5	291.0	310.3	311.2	1.579	1.730
12.000	116.640	8.573	1360.1	-121.91	-121.91	436	294.2	18.6	2.164	283.5	291.0	310.3	311.2	1.579	1.730
13.000	130.635	7.655	1328.8	-123.28	-123.28	434	296.3	18.0	2.354	283.5	291.0	310.3	311.2	1.579	1.730
14.000	145.027	6.895	1300.0	-124.52	-124.52	432	298.1	17.5	2.541	283.5	291.0	310.3	311.2	1.579	1.730
15.000	159.730	6.261	1273.8	-125.64	-125.64	430	299.7	17.1	2.727	283.5	291.0	310.3	311.2	1.579	1.730
16.000	174.664	5.725	1249.8	-126.68	-126.68	428	301.2	16.7	2.911	283.5	291.0	310.3	311.2	1.579	1.730
17.000	189.753	5.270	1227.5	-127.63	-127.63	427	302.6	16.3	3.093	283.5	291.0	310.3	311.2	1.579	1.730
18.000	204.933	4.880	1206.9	-128.51	-128.51	425	303.8	16.0	3.270	283.5	291.0	310.3	311.2	1.579	1.730
19.000	220.152	4.542	1187.6	-129.33	-129.33	424	305.0	15.6	3.444	283.5	291.0	310.3	311.2	1.579	1.730
20.000	235.368	4.249	1169.5	-130.09	-130.09	422	306.1	15.4	3.613	283.5	291.0	310.3	311.2	1.579	1.730
21.000	250.555	3.991	1152.6	-130.80	-130.80	421	307.1	15.1	3.778	283.5	291.0	310.3	311.2	1.579	1.730
22.000	265.693	3.734	1136.6	-131.48	-131.48	420	308.1	14.8	3.940	283.5	291.0	310.3	311.2	1.579	1.730
23.000	280.788	3.503	1121.4	-132.11	-132.11	418	309.0	14.6	4.103	283.5	291.0	310.3	311.2	1.579	1.730
24.000	295.842	3.295	1107.1	-132.71	-132.71	417	309.8	14.4	4.267	283.5	291.0	310.3	311.2	1.579	1.730
25.000	310.857	3.108	1093.5	-133.28	-133.28	416	310.6	14.1	4.431	283.5	291.0	310.3	311.2	1.579	1.730
26.000	325.832	2.939	1080.5	-133.81	-133.81	415	311.4	13.9	4.595	283.5	291.0	310.3	311.2	1.579	1.730
27.000	340.767	2.788	1068.2	-134.33	-134.33	414	312.2	13.6	4.759	283.5	291.0	310.3	311.2	1.579	1.730
28.000	355.662	2.647	1056.5	-134.81	-134.81	413	312.7	13.4	4.923	283.5	291.0	310.3	311.2	1.579	1.730
29.000	370.517	2.521	1045.2	-135.28	-135.28	412	313.4	13.4	5.087	283.5	291.0	310.3	311.2	1.579	1.730
30.000	385.332	2.405	1034.4	-135.72	-135.72	411	314.0	13.2	5.251	283.5	291.0	310.3	311.2	1.579	1.730
31.000	400.107	2.298	1024.1	-136.15	-136.15	410	314.6	13.0	5.415	283.5	291.0	310.3	311.2	1.579	1.730
32.000	414.842	2.202	1014.1	-136.55	-136.55	409	315.2	12.9	5.579	283.5	291.0	310.3	311.2	1.579	1.730
33.000	429.537	2.113	1004.6	-136.95	-136.95	409	315.7	12.8	5.743	283.5	291.0	310.3	311.2	1.579	1.730
34.000	444.192	2.031	995.4	-137.32	-137.32	408	316.2	12.6	5.907	283.5	291.0	310.3	311.2	1.579	1.730
35.000	458.807	1.955	986.5	-137.68	-137.68	407	316.7	12.5	6.071	283.5	291.0	310.3	311.2	1.579	1.730
36.000	473.382	1.885	977.9	-138.03	-138.03	406	317.2	12.4	6.235	283.5	291.0	310.3	311.2	1.579	1.730
37.000	487.917	1.819	969.7	-138.37	-138.37	405	317.6	12.3	6.399	283.5	291.0	310.3	311.2	1.579	1.730
38.000	502.412	1.759	961.7	-138.69	-138.69	405	318.1	12.1	6.563	283.5	291.0	310.3	311.2	1.579	1.730
39.000	516.867	1.702	954.0	-139.00	-139.00	404	318.5	12.0	6.727	283.5	291.0	310.3	311.2	1.579	1.730
40.000	531.282	1.650	946.5	-139.31	-139.31	403	318.9	11.9	6.891	283.5	291.0	310.3	311.2	1.579	1.730
41.000	545.657	1.601	939.2	-139.60	-139.60	403	319.3	11.8	7.055	283.5	291.0	310.3	311.2	1.579	1.730
42.000	560.002	1.549	932.2	-139.88	-139.88	402	319.7	11.7	7.219	283.5	291.0	310.3	311.2	1.579	1.730
43.000	574.317	1.498	925.3	-140.16	-140.16	402	320.1	11.6	7.383	283.5	291.0	310.3	311.2	1.579	1.730
44.000	588.592	1.449	918.5	-140.43	-140.43	401	320.5	11.5	7.547	283.5	291.0	310.3	311.2	1.579	1.730
45.000	602.827	1.403	912.2	-140.68	-140.68	400	320.8	11.4	7.711	283.5	291.0	310.3	311.2	1.579	1.730
46.000	617.022	1.360	905.9	-140.94	-140.94	400	321.1	11.3	7.875	283.5	291.0	310.3	311.2	1.579	1.730
47.000	631.177	1.319	899.8	-141.18	-141.18	399	321.5	11.2	8.039	283.5	291.0	310.3	311.2	1.579	1.730
48.000	645.292	1.280	893.8	-141.42	-141.42	399	321.8	11.2	8.203	283.5	291.0	310.3	311.2	1.579	1.730
49.000	659.367	1.243	888.0	-141.65	-141.65	398	322.1	11.1	8.367	283.5	291.0	310.3	311.2	1.579	1.730
50.000	673.402	1.208	882.3	-141.88	-141.88	398	322.4	11.0	8.531	283.5	291.0	310.3	311.2	1.579	1.730
8.156	68.046	16.696	1521.3	-114.79	-114.79	447	283.5	21.6	1.467	283.5	290.0	302.6	305.1	1.576	1.696

SHIPPING EXPANSION															
C STAR = 5892.4 FT/SEC															
EPSILON	PC/F	P PSIA	TEMP DEG K	ENTHALPY KCAL/1000G	CP CAL/DEG	I OPT	DELVAC DEG F	I SEA	I AT 10000	I AT 50000	I VAC	CF SEA	CF VAC		
1.000	1.000	1000.000	3440.0	-40.01	-40.01	498	122.5	104.1	1.183	223.9	224.7	226.3	226.6	1.237	1.223
2.000	1.760	568.283	3202.9	-70.05	-70.05	479	224.3	40.2	1.379	262.9	264.6	267.9	268.5	1.436	1.444
3.000	9.266	107.624	2288.0	-91.32	-91.32	471	249.5	38.5	1.958	276.6	279.0	283.8	284.8	1.510	1.555
4.000	25.414	39.368	1847.0	-60.05	-60.05	464	258.7	29.0	1.736	276.5	279.7	286.0	287.1	1.537	1.597
5.000	34.683	28.833	1751.0	-104.40	-104.40	459	267.1	26.3	1.912	280.0	284.1	291.9	293.4	1.557	1.631
6.000	44.330	22.558	1641.8	-108.47	-108.47	454	273.7	24.4	1.082	282.2	286.9	296.2	298.1	1.568	1.657
7.000	55.153	18.132	1589.7	-111.72	-111.72	450	278.8	22.9	1.264	283.1	288.7	299.5	301.7	1.574	1.677
8.000	66.285	15.086	1529.8	-114.41	-114.41	447	282.9	21.7	1.440	283.5	289.9	302.2	304.7	1.576	1.694
9.000	78.144	12.787	1478.8	-116.89	-116.89	444	286.4	20.7	1.621	283.5	290.5	304.4	307.2	1.578	1.708
10.000	90.444	11.056	1434.2	-118.86	-118.86	441	289.4	19.9	1.801	283.5	290.8	308.2	309.3	1.579	1.719
11.000	103.129	9.697	1395.1	-120.38	-120.38	439	292.0	19.2	1.980	283.5	291.0	310.3	311.2	1.579	1.730
12.000	104.996	9.531	1381.8	-122.22	-122.22	436	294.2	18.6	2.160	283.5	292.5	312.6	313.4	1.579	1.739
13.000	117.178	8.538	1358.4	-124.77	-124.77	433	296.2	18.0	2.340	283.5	293.5	314.9	315.6	1.579	1.748
14.000	129.782	7.709	1337.2	-126.88	-126.88	430	298.1	17.4	2.520	283.5	294.5	317.2	317.8	1.579	1.757
15.000	142.874	7.009	1315.0	-128.66	-128.66	427	300.0	16.8	2.700	283.5	295.5	319.5	320.1	1.579	1.766
16.000	155.783	6.419	1306.0	-130.63	-130.63	424	301.7	16.0	2.880	283.5	296.5	321.7	322.3	1.579	1.775
17.000	169.048	5.915	1283.4	-133.71	-133.71	421	311.2	15.6	3.151	283.5	297.5	324.5	325.7	1.579	1.801
18.000	182.456	5.472	1264.2	-136.82	-136.82	418	311.2	15.2	3.422	283.5	298.5	327.2	328.4	1.579	1.827
19.000	195.816	5.107	1244.0	-139.65	-139.65	415	313.9	14.8	3.700	283.5	299.5	329.5	331.9	1.579	1.852
20.000	209.224	4.780	1224.9	-143.53	-143.53	412	315.1	14.7	3.980	283.5	299.5	332.8	334.8	1.579	1.877
21.000	222.956	4.492	1207.8	-147.35	-147.35	409	316.2	14.4	4.260	283.5	299.5	335.7	337.7	1.579	1.902
22.000	235.907	4.239	1193.4	-150.12	-150.12	406	317.3	14.2	4.540	283.5	299.5	338.4	340.4	1.579	1.926
23.000	248.159	4.016	1179.7	-152.84	-152.84	403	318.3	14.0	4.820	283.5	299.5	341.1	343.1	1.579	1.950
24.000	263.956	3.788	1162.4	-155.93	-155.93	400	320.2	13.7	5.100	283.5	299.5	343.8	345.8	1.579	1.974
25.000	279.380	3.579	1148.9	-160.19	-160.19	397	321.1	13.5	5.404	283.5	299.5	346.6	348.6	1.579	1.998
26.000	294.914	3.390	1136.0	-164.81	-164.81	394	321.0	13.3	5.682	283.5	299.5	349.1	351.3	1.579	1.992
27.000	310.752	3.219	1124.2	-169.81	-169.81	391	321.0	13.1	5.960	283.5	299.5	351.6	353.8	1.579	1.996
28.000	326.888	3.061	1112.2	-174.97	-174.97	388	322.5	12.9	6.198	283.5	299.5	354.4	356.4	1.579	1.999
29.000	342.754	2.910	1101.1	-180.50	-180.50	385	323.3	12.7	6.395	283.5	299.5	356.8	358.0	1.579	1.991
30.000	358.925	2.766	1090.1	-186.02	-186.02	382	324.0	12.6	6.591	283.5	299.5	359.0	360.0	1.579	1.994
31.000	375.117	2.683	1080.3	-191.51	-191.51	379	324.6	12.5	6.786	283.5	299.5	361.2	362.0	1.579	1.997
32.000	391.880	2.611	1070.7	-197.00	-197.00	376	324.6	12.3	6.980	283.5	299.5	363.4	364.0	1.579	1.999
33.000	407.824	2.452	1061.2	-202.44	-202.44	373	325.9	12.1	7.172	283.5	299.5	365.5	366.0	1.579	1.997
34.000	424.114	2.350	1052.2	-207.88	-207.88	370	326.5	12.0	7.363	283.5	299.5	367.6	368.0	1.579	1.994
35.000	440.915	2.270	1043.5	-213.30	-213.30	367	327.0	11.9	7.551	283.5	299.5	369.7	369.0	1.579	1.987
36.000	458.027	2.199	1035.1	-218.71	-218.71	364	327.4	11.7	7.741	283.5	299.5	371.8	370.0	1.579	1.980
37.000	475.054	2.114	1027.2	-224.11	-224.11	361	328.1	11.6	7.920	283.5	299.5	373.9	372.0	1.579	1.971
38.000	492.959	2.044	1019.4	-229.48	-229.48	358	328.6	11.5	8.101	283.5	299.5	376.0	374.0	1.579	1.973
39.000	505.429	1.979	1011.9	-234.85	-234.85	355	329.1	11.4	8.280	283.5	299.5	378.1	376.0	1.579	1.975
40.000	521.473	1.918	1004.7	-240.21	-240.21	352	329.5	11.3	8.455	283.5	299.5	380.1	378.0	1.579	1.977
41.000	537.491	1.875	1000.7	-245.57	-245.57	349	329.7	11.2	8.630	283.5	299.5	382.1	380.0	1.579	1.979
42.000	553.261	1.807	1100.9	-247.89	-247.89	346	330.4	11.1	7.994	283.5	299.5	384.1	382.0	1.579	1.981
43.000	568.992	1.757	1104.3	-248.21	-248.21	343	330.9	11.0	7.769	283.5	299.5	386.1	384.0	1.579	1.983
44.000	584.007	1.711	1117.9	-248.52	-248.52	340	331.3	11.0	8.193	283.5	299.5	388.1	386.0	1.579	1.985
45.000	600.107	1.666	1128.7	-248.83	-248.83	337	331.7	10.9	8.292	283.5	299.5	390.1	388.0	1.579	1.988
46.000	616.480	1.619	1140.7	-249.13	-249.13	334	332.1	10.8	8.391	283.5	299.5	392.1	390.0	1.579	1.990
47.000	630.738	1.585	1155.8	-249.42	-249.42	332	332.4	10.6	8.604	283.5	299.5	394.1	392.0	1.579	1.990
48.000	646.978	1.561	1154.2	-249.70	-249.70	332	332.8	10.6	8.804	283.5	299.5	396.1	394.0	1.579	1.991
49.000	667.357	1.498	1188.6	-249.97	-249.97	332	333.2	10.5	9.000	283.5	299.5	398.1	396.0	1.579	1.993
50.000	685.944	1.452	1204.2	-250.24	-250.24	332	333.5	10.4	9.199	283.5	299.5	400.1	398.0	1.579	1.994
0.725	88.048	10.946	1759.1	-120.67	-120.67	452	299.4	23.5	1.999	292.4	299.5	313.2	313.9	1.597	1.723

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 02 1.14 -3.08 7C.
 RP-1 298 C₈H₁₈ 0.80 -6.92 3C.

BULK DENSITY = 1.011 GM/CC
 MIXTURE RATIO = 2.333 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 274.68 EU/100GMS

CHAMBER													THROAT
FROZEN EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	561.8
TEMP, DEG K	3577.6	3029.7	2557.7	2151.0	1800.3	1618.9	1497.9	1237.5	1013.9	823.3	662.3	528.1	3225.1
ENTHALPY (-)	21.59	48.42	71.12	90.23	106.28	114.38	119.68	130.78	139.92	147.38	153.41	158.24	38.91
CP	.4938	.4855	.4758	.4641	.4505	.4415	.4349	.4174	.3998	.3824	.3664	.3534	.4886
IMPUL OPT		152.79	207.57	244.37	271.44	284.11	292.12	308.21	320.85	330.80	338.64	344.78	122.75
IMPUL VAC		229.02	254.95	278.21	296.94	306.02	311.83	323.65	333.00	340.37	346.16	350.67	223.76
EPSILON		1.065	1.662	2.983	5.646	8.291	10.965	21.566	42.635	84.344	166.499	327.543	1.000
SHIFTING EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	572.4
TEMP, DEG K	3577.6	3238.7	2905.3	2561.0	2212.7	2018.6	1886.6	1599.9	1355.6	1151.3	983.2	846.0	3370.5
ENTHALPY (-)	21.59	49.05	73.40	94.82	113.40	122.96	129.30	142.80	154.25	163.96	172.22	179.31	38.61
X BAR	4.447	4.363	4.300	4.262	4.247	4.244	4.243	4.242	4.242	4.242	4.242	4.242	4.394
N	4.447	4.363	4.300	4.262	4.247	4.244	4.243	4.242	4.242	4.242	4.242	4.242	4.394
CP	1.2200	1.0183	.7865	.6054	.5117	.4872	.4774	.4688	.4702	.4818	.5032	.5308	1.1051
IMPUL OPT		154.58	212.32	252.41	282.61	296.97	306.11	324.73	339.72	351.93	362.00	370.41	121.70
IMPUL VAC		233.61	263.19	289.80	311.36	321.91	328.71	342.80	354.35	363.93	371.96	378.79	226.91
EPSILON		1.080	1.746	3.224	6.226	9.232	12.299	24.691	50.230	103.442	215.724	455.661	1.000
COMPOSITION SHIFTING (MOL/100 GM)													
170.89 C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
142.00 C+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-2.90 C+H+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
67.00 C+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-27.70 C+H2+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
31.94 C+H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-17.89 C+H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-26.42 C+O	1.5998	1.5498	1.5078	1.4722	1.4322	1.4025	1.3769	1.2998	1.1965	1.0634	.9029	.7234	1.5686
-94.05 C+O2	.5455	.5960	.6382	.6739	.7139	.7436	.7692	.8463	.9497	1.0827	1.2432	1.4227	.5770
199.00 C2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
112.10 C2+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
54.19 C2+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
12.50 C2+H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
189.70 C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
242.30 C4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.1283	.0887	.0527	.0238	.0072	.0030	.0014	.0002	.0000	.0000	.0000	.0000	.1040
9.33 H+O	.1783	.1070	.0503	.0157	.0028	.0008	.0003	.0000	.0000	.0000	.0000	.0000	.1338
.00 H2	.5166	.5081	.5143	.5381	.5786	.6094	.6355	.7130	.8165	.9496	1.1101	1.2895	.5100
-57.80 H2+O	1.4253	1.4895	1.5298	1.5378	1.5121	1.4844	1.4594	1.3826	1.2792	1.1461	.9856	.8062	1.4665
59.56 O	.0251	.0109	.0031	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0157
.00 O2	.0273	.0127	.0038	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0179

SYSTEM LIQUID BIPROPELLANT
COMPONENT TREF FORMULA
LOX 90.2 02
RP-1 298 C=0.1493

PC 1000. PSIA
DENSITY
G/CC
1.14
0.80

HEAT FORM
(KCAL/FORM.WT.)
-3.08
-6.92

WT. 0/0
7C.
3C.

PROZEN EXPANSION
C STAR 5913.0 FT/SEC

EPSILON	PC/P	P PSIA	TEMP DEG K	ENTHALPY KCAL/100GM	CP CAL/ I OPT G/CC DEG	DELTA VAC DELTA VAC /P	I SEA LVL	I AT 10000	I AT 50000	I VAC	CF SEA LVL	CF VAC LVL
1.000	1.000	1000.000	3577.6	-21.53	496	101.0	221.1	221.9	221.9	221.9	1.230	1.245
2.000	1.740	561.182	3225.8	-38.91	489	101.0	221.1	221.9	221.9	221.9	1.434	1.465
3.000	15.964	62.523	2147.5	-40.40	484	101.0	221.1	221.9	221.9	221.9	1.504	1.540
4.000	25.003	39.905	1980.1	-48.12	450	101.0	221.1	221.9	221.9	221.9	1.539	1.599
5.000	34.113	29.314	1861.5	-103.52	453	101.0	221.1	221.9	221.9	221.9	1.559	1.636
6.000	43.448	23.016	1770.3	-107.63	448	101.0	221.1	221.9	221.9	221.9	1.572	1.660
7.000	54.000	18.518	1696.4	-110.96	445	101.0	221.1	221.9	221.9	221.9	1.578	1.681
8.000	64.842	15.422	1634.9	-113.67	442	101.0	221.1	221.9	221.9	221.9	1.580	1.698
9.000	76.301	13.106	1582.4	-115.98	440	101.0	221.1	221.9	221.9	221.9	1.578	1.712
10.000	88.244	11.332	1536.8	-117.98	437	101.0	221.1	221.9	221.9	221.9	1.574	1.724
11.000	100.451	9.955	1496.8	-119.74	435	101.0	221.1	221.9	221.9	221.9	1.568	1.735
12.000	113.449	8.811	1460.6	-121.29	433	101.0	221.1	221.9	221.9	221.9	1.564	1.744
13.000	126.942	7.875	1428.2	-122.69	431	101.0	221.1	221.9	221.9	221.9	1.561	1.752
14.000	140.880	7.098	1398.8	-123.96	429	101.0	221.1	221.9	221.9	221.9	1.564	1.760
15.000	155.075	6.449	1371.9	-125.11	427	101.0	221.1	221.9	221.9	221.9	1.567	1.767
16.000	169.458	5.900	1347.1	-126.16	425	101.0	221.1	221.9	221.9	221.9	1.573	1.773
17.000	184.080	5.432	1324.2	-127.13	424	101.0	221.1	221.9	221.9	221.9	1.579	1.779
18.000	198.758	5.031	1302.9	-128.03	422	101.0	221.1	221.9	221.9	221.9	1.586	1.786
19.000	213.499	4.688	1283.0	-128.87	421	101.0	221.1	221.9	221.9	221.9	1.591	1.789
20.000	228.202	4.382	1264.4	-129.65	419	101.0	221.1	221.9	221.9	221.9	1.594	1.794
21.000	242.867	4.117	1246.9	-130.39	418	101.0	221.1	221.9	221.9	221.9	1.598	1.798
22.000	258.432	3.869	1230.4	-131.08	417	101.0	221.1	221.9	221.9	221.9	1.602	1.802
23.000	275.338	3.632	1214.8	-131.73	416	101.0	221.1	221.9	221.9	221.9	1.606	1.806
24.000	292.840	3.418	1200.0	-132.34	415	101.0	221.1	221.9	221.9	221.9	1.609	1.809
25.000	310.011	3.226	1185.9	-132.93	414	101.0	221.1	221.9	221.9	221.9	1.612	1.812
26.000	327.715	3.051	1172.5	-133.48	413	101.0	221.1	221.9	221.9	221.9	1.616	1.816
27.000	345.619	2.893	1159.7	-134.01	412	101.0	221.1	221.9	221.9	221.9	1.619	1.819
28.000	363.650	2.750	1147.5	-134.51	411	101.0	221.1	221.9	221.9	221.9	1.622	1.822
29.000	381.857	2.619	1135.9	-134.99	410	101.0	221.1	221.9	221.9	221.9	1.624	1.824
30.000	400.200	2.498	1124.7	-135.44	409	101.0	221.1	221.9	221.9	221.9	1.627	1.827
31.000	418.556	2.389	1114.0	-135.88	408	101.0	221.1	221.9	221.9	221.9	1.629	1.829
32.000	437.031	2.288	1103.7	-136.30	407	101.0	221.1	221.9	221.9	221.9	1.632	1.832
33.000	455.668	2.195	1093.7	-136.71	406	101.0	221.1	221.9	221.9	221.9	1.634	1.834
34.000	473.945	2.110	1084.2	-137.09	405	101.0	221.1	221.9	221.9	221.9	1.636	1.836
35.000	492.380	2.031	1075.0	-137.47	405	101.0	221.1	221.9	221.9	221.9	1.638	1.838
36.000	510.775	1.958	1066.1	-137.83	404	101.0	221.1	221.9	221.9	221.9	1.640	1.840
37.000	529.114	1.890	1057.5	-138.17	403	101.0	221.1	221.9	221.9	221.9	1.642	1.842
38.000	547.386	1.827	1049.2	-138.51	403	101.0	221.1	221.9	221.9	221.9	1.644	1.844
39.000	565.578	1.768	1041.1	-138.83	402	101.0	221.1	221.9	221.9	221.9	1.646	1.846
40.000	583.684	1.713	1033.4	-139.14	401	101.0	221.1	221.9	221.9	221.9	1.648	1.848
41.000	601.698	1.662	1025.8	-139.45	401	101.0	221.1	221.9	221.9	221.9	1.649	1.849
42.000	619.619	1.614	1018.5	-139.74	400	101.0	221.1	221.9	221.9	221.9	1.651	1.851
43.000	637.612	1.566	1011.3	-140.03	400	101.0	221.1	221.9	221.9	221.9	1.653	1.853
44.000	655.757	1.516	1004.4	-140.30	399	101.0	221.1	221.9	221.9	221.9	1.654	1.854
45.000	673.108	1.468	997.7	-140.57	398	101.0	221.1	221.9	221.9	221.9	1.656	1.856
46.000	690.657	1.423	991.1	-140.83	398	101.0	221.1	221.9	221.9	221.9	1.657	1.857
47.000	708.352	1.380	984.8	-141.08	397	101.0	221.1	221.9	221.9	221.9	1.659	1.859
48.000	726.304	1.340	978.5	-141.33	397	101.0	221.1	221.9	221.9	221.9	1.660	1.860
49.000	744.383	1.301	972.5	-141.57	396	101.0	221.1	221.9	221.9	221.9	1.661	1.861
50.000	762.617	1.265	966.6	-141.80	396	101.0	221.1	221.9	221.9	221.9	1.663	1.863
8.291	28.046	14.496	1618.7	-114.38	441	284.1	290.7	303.5	306.0	1.580	1.702	

SHIFTING EXPANSION
C STAR 5913.0 FT/SEC

EPSILON	PC/P	P PSIA	TEMP DEG K	ENTHALPY KCAL/100GM	CP CAL/ I OPT G/CC DEG	DELTA VAC DELTA VAC /P	I SEA LVL	I AT 10000	I AT 50000	I VAC	CF SEA LVL	CF VAC LVL
1.000	1.000	1000.000	3577.6	-21.59	1.270							
2.000	1.747	572.393	3370.5	-38.61	1.105	121.7	105.2	104.2	226.0	226.0	1.234	1.220
3.000	2.147	472.641	3242.5	-52.66	737	121.7	105.2	104.2	226.0	226.0	1.438	1.469
4.000	14.826	67.451	2598.9	-52.66	621	248.9	30.5	567	278.8	281.3	206.2	207.1
5.000	21.955	45.368	2446.4	-101.11	545	248.9	36.1	748	286.5	289.6	297.5	297.5
6.000	30.085	33.239	2325.7	-107.82	534	273.6	41.2	938	291.0	295.2	303.2	304.8
7.000	38.077	26.290	2231.5	-112.45	515	281.1	46.1	1129	296.0	299.9	312.5	314.0
8.000	46.870	21.336	2153.6	-116.35	503	281.1	51.5	1290	295.7	301.4	312.5	315.7
9.000	56.235	17.783	2087.7	-119.61	494	292.0	56.2	1475	296.6	303.1	315.7	318.2
10.000	65.757	15.198	2030.8	-122.88	488	296.1	57.2	1656	299.3	308.4	318.4	321.3
11.000	75.858	13.183	1981.1	-124.78	484	299.6	58.3	1840	305.0	320.7	323.9	327.0
12.000	86.254	11.594	1937.0	-126.89	481	299.6	59.7	2028	307.7	323.9	327.0	330.1
13.000	96.827	10.228	1897.6	-128.77	478	305.4	62.8	2207	305.5	324.8	328.2	332.5
14.000	107.864	9.211	1862.0	-130.47	476	307.8	62.2	2393	303.0	325.0	330.0	334.0
15.000	119.371	8.377	1829.6	-132.00	474	309.9	61.6	2586	302.7	327.2	331.6	336.4
16.000	131.110	7.624	1800.0	-133.41	471	312.1	61.2	2783	301.3	328.3	333.4	338.6
17.000	143.210	6.983	1772.7	-134.70	469	313.7	60.7	2987	300.4	329.4	334.4	340.9
18.000	155.437	6.433	1747.5	-135.89	467	315.3	60.3	3198	300.3	330.5	335.7	342.6
19.000	167.802	5.959	1724.0	-136.99	464	316.9	59.9	3417	300.1	331.1	336.8	344.3
20.000	180.258	5.546	1702.1	-138.02	461	318.6	59.5	3643	300.0	331.8	337.8	346.0
21.000	192.764	5.188	1681.5	-138.98	458	319.6	59.3	3879	300.0	332.5	338.6	347.8
22.000	205.264	4.871	1662.7	-139.89	455	320.8	59.0	4100	300.0	333.2	339.8	349.4
23.000	217.767	4.592	1644.1	-140.74	452	322.0	58.7	4308	300.0	333.7	340.7	350.9
24.000	230.251	4.343	1626.9	-141.54	449	323.8	58.5	4522	300.0	334.3	341.5	352.5
25.000	242.698	4.121	1610.6	-142.30	446	325.0	58.3	4742	300.0	334.7	342.5	354.0
26.000	255.142	3.913	1595.2	-143.02	443	325.0	58.0	4959	300.0	335.0	343.5	355.6
27.000	267.575	3.707	1580.5	-143.71	440	325.9	57.8	5177	300.0	335.3	344.7	357.0
28.000	280.004	3.519	1566.6	-144.37	437	326.8	57.6	5395	300.0	335.9	346.4	358.4
29.000	292.449	3.347	1553.2	-144.99	434	327.6	57.4	5617	300.0	336.2	347.4	359.7
30.000	304.888	3.190	1540.3	-145.59	431	328.4	57.2	5831	300.0	336.4	348.4	361.0
31.000	317.340	3.045	1527.9	-146.16	428	329.2	57.0	6050	300.0	336.7	349.2	362.2
32.000	329.795	2.913	1516.6	-146.71	425	329.9	56.9	6266	300.0	337.0	350.0	363.4
33.000	342.222	2.790	1505.3	-147.23	422	330.7	56.7	6481	300.0	337.3	350.7	364.6
34.000	354.611	2.677	1494.9	-147.74	419	331.3	56.5	6697	300.0	337.6	351.3	365.8
35.000	366.973	2.572	1484.1	-148.22	416	331.9	56.4	6913	300.0	337.8	351.8	366.9
36.000	379.340	2.475	1474.1	-148.69	413	332.5	56.3	7126	300.0	337.9	352.0	368.0
37.000	391.744	2.384	1464.5	-149.15	410	333.1	56.1	7339	300.0	338.0	352.1	369.1
38.000	404.191	2.301	1455.1	-149.58	407	333.7	56.0	7547	300.0	338.1	352.2	370.2
39.000	416.688	2.223	1446.1	-149.98	404	334.2	55.9	7754	300.0	338.2	352.3	371.3
40.000	429.235	2.151	1437.4	-150.41	401	334.8	55.8	7959	300.0	338.3	352.4	372.4
41.000	441.790	2.083	1428.9	-150.81	398	335.3	55.7	8162	300.0	338.4	352.5	373.5
42.000	454.356	2.019	1420.6	-151.19	395	335.8	55.6	8364	300.0	338.5	352.6	374.6
43.000	466.939	1.960	1412.8	-151.56	393	336.3	55.4	8561	300.0	338.5	352.7	375.7
44.000	479.528	1.904	1405.2	-151.92	390	336.7	55.3	8757	300.0	338.6	352.8	376.8
45.000	492.119	1.851	1397.7	-152.27	387	337.2	55.2	8951	300.0	338.6	352.8	377.9
46.000	504.725	1.800	1390.4	-152.60	384	337.6	55.1	9144	300.0	338.7	352.9	379.0
47.000	517.349	1.755	1383.7	-152.93	381	338.0	55.0	9340	300.0	338.8	353.1	380.1
48.000	530.851	1.711	1376.5	-153.27	378	338.4	54.9	9539	300.0	338.8	353.4	381.2
49.000	544.338	1.670	1369.4	-153.58	375	338.8	54.8	9739	300.0	338.9	353.7	382.3
50.000	557.819	1.631	1362.4	-153.89	372	339.2	54.7	9939	300.0	339.0	354.0	383.4
51.000	571.294	1.593	1355.7	-154.18	369	339.6	54.6	10137	300.0	339.1	354.3	384.5
52.000	584.764	1.558	1349.0	-154.46	367	340.0	54.5	10334	300.0	339.2	354.6	385.6
53.000	598.229	1.525	1342.4	-154.73	364	340.4	54.4	10530	300.0	339.3	354.9	386.7
54.000	611.689	1.494	1335.9	-154.99	361	340.8	54.3	10726	300.0	339.4	355.2	387.8
55.000	625.144	1.464	1329.4	-155.24	358	341.2	54.2	10921	300.0	339.5	355.5	388.9
56.000	638.594	1.435	1323.0	-155.49	355	341.6	54.1	11116	300.0	339.6	355.8	389.9
57.000	652.039	1.407	1316.7	-155.73	352	342.0	54.0	11311	300.0	339.7	356.1	391.0
58.000	665.479	1.380	1310.5	-155.96	349	342.4	53.9	11506	300.0	339.8	356.4	392.1
59.000	678.914	1.354	1304.4	-156.19	346	342.8	53.8	11701	300.0	339.9	356.7	393.2
60.000	692.344	1.329	1298.4	-156.41	343	343.2	53.7	11896	300.0	340.0	357.0	394.3
61.000	705.769	1.305	1292.5	-156.62	340	343.6	53.6	12091	300.0	340.1	357.3	395.4
62.000	719.189	1.282	1286.7	-156.83	337	344.0	53.5	12286	300.0	340.2	357.6	396.5
63.000	732.604	1.260	1281.0	-157.04	334	344.4	53.4	12481	300.0	340.3	357.9	397.6
64.000	746.014	1.239	1275.4	-157.24	331	344.8	53.3	12676	300.0	340.4	358.2	398.7
65.000	759.419	1.219	1270.0	-157.44	328	345.2	53.2	12871	300.0	340.5	358.5	399.8
66.000	772.819	1.199	1264.7	-157.63	325	345.6	53.1	13066	300.0	340.6	358.8	400.9
67.000	786.214	1.180	1259.5	-157.82	322	346.0	53.0	13261	300.0	340.7	359.1	402.0
68.000	799.604	1.162	1254.4	-158.00	319	346.4	52.9	13456	300.0	340.8	359.4	403.1
69.000	813.000	1.144	1249.4	-158.18	316	346.8	52.8	13651	300.0	340.9	359.7	404.2
70.000	826.391	1.127	1244.5	-158.35	313	347.2	52.7	13846	300.0	341.0	360.0	405.3
71.000	839.777	1.111	1239.7	-158.52	310	347.6	52.6	14041	300.0	341.1	360.3	406.4
72.000	853.159	1.095	1235.0	-158.68	307	348.0	52.5	14236	300.0	341.2	360.6	407.5
73.000	866.536	1.080	1230.4	-158.84	304	348.4	52.4	14431	300.0	341.3	360.9	408.6
74.000	879.909	1.065	1225.9	-158.99	301	348.8	52.3	14626	300.0	341.4	361.2	409.7
75.000	893.277	1.051	1221.5	-159.14	298	349.2	52.2	14821	300.0	341.5	361.5	410.8
76.000	906.640	1.037	1217.2	-159.28	295	349.6	52.1	15016	300.0	341.6	361.8	411.9
77.000	919.998	1.024	1213.0	-159.42	292	350.0	52.0	15211	300.0	341.7	362.1	413.0
78.000	933.351	1.011	1208.9	-159.55	289	350.4	51.9	15406	300.0	341.8	362.4	414.1
79.000	946.700	1.000	1204.9	-159.68	286	350.8	51.8	15601	300.0	341.9	362.7	415.2
80.000	959.944	0.989	1201.0	-159.80	283	351.2	51.7	15796	300.0	342.0	363.0	416.3
81.000	973.184	0.979	1197.2	-159.92	280	351.6	51.6	15991	300.0	342.1	363.3	417.4
82.000	986.419	0.969	1193.5	-160.04	277	352.0	51.5	16186	300.0	342.2	363.6	418.5
83.000	999.650	0.960	1189.9	-160.15	274	352.4	51.4	16381	300.0	342.3	363.9	419.6
84.000	1012.876	0.951	1186.4	-160.26	271	352.8	51.3	16576	300.0	342.4	364.2	420.7
85.000	1026.098	0.943	1183.0	-160.36	268	353.2	51.2	16771	300.0	342.5	364.5	421.8
86.000	1039.316	0.935	1179.6	-160.46	265	353.6	51.1	16966	300.0	342.6	364.8	422.9
87.000	1052.530	0.927	1176.3	-160.56	262	354.0	51.0	17161	300.0	342.7	365.1	424.0
88.000	1065.740	0.920	1173.1	-160.66	259	354.4	50.9	17356	300.0	342.8	365.4	425.1
89.000	1078.946	0.913	1169.9	-160.75	256	354.8	50.8	17551	300.0	342.9	365.7	426.2
90.000	1092.148	0.906	1166.8	-160.84	253	355.2	50.7	17746	300.0	343.0	366.0	427.3
91.000	1105.346	0.900	1163.8	-160.93	250	355.6						

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 100C, PSIA PE 0.1 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 LEG K
 LEX 90.2 02 1.14 -3.04 72.5
 RP-1 296 C+H_{1.953} 0.80 -6.92 27.5

BULK DENSITY = 1.021 GM/CC
 MIXTURE RATIO = 2.636 LH OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 267.73 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	559.4
TEMP, DEG K	3668.8	3118.7	2643.3	2232.7	1877.6	1693.5	1570.6	1305.4	1076.5	880.2	713.5	572.7	5312.5
ENTHALPY (-)	20.59	46.81	69.08	87.91	103.79	111.84	117.11	128.22	137.42	144.97	151.13	156.09	37.62
CP	.4804	.4726	.4636	.4530	.4408	.4325	.4264	.4102	.3935	.3763	.3604	.3463	.4757
IMPUL OPT	151.03	205.38	242.00	269.04	281.74	289.78	306.00	318.00	328.95	336.99	343.33	349.43	121.72
IMPUL VAC	226.55	252.45	275.74	294.56	303.72	309.60	321.60	331.15	338.74	344.73	349.43	352.24	221.24
EPSILON	1.066	1.669	3.006	5.711	8.408	11.142	22.025	43.794	67.179	173.214	342.910	1.000	
	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	575.0
TEMP, DEG K	3668.8	3369.0	3095.2	2831.8	2557.9	2386.3	2258.4	1953.4	1673.3	1429.1	1220.6	1045.4	3485.1
ENTHALPY (-)	20.59	47.50	71.68	93.44	112.92	123.24	130.17	145.17	156.06	169.08	178.48	186.53	37.07
X BAR	4.230	4.133	4.047	3.975	3.924	3.906	3.898	3.890	3.889	3.888	3.888	3.888	4.171
N	4.230	4.133	4.047	3.975	3.924	3.906	3.898	3.890	3.889	3.888	3.888	3.888	4.171
CP	1.5468	1.4554	1.2761	1.0110	.7256	.6011	.5416	.4755	.4503	.4545	.4545	.4660	1.5020
IMPUL OPT	153.00	210.82	251.74	284.42	298.83	308.75	329.21	345.82	359.41	370.62	379.95	389.75	119.75
IMPUL VAC	251.68	267.19	290.40	314.04	325.77	334.40	349.16	362.09	372.78	381.69	389.20	396.69	224.69
EPSILON	1.064	1.778	3.361	6.666	10.066	13.522	27.495	56.298	116.203	241.760	507.350	1.000	
	COMPOSITION SHIFTING (MOL/100 GM)												
170.89 C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
142.00 C+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-2.90 C+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
67.00 C+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-27.70 C+H2+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
31.94 C+H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-17.89 C+H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-26.42 C+O	1.3022	1.2220	1.1572	1.0947	1.0466	1.0250	1.0108	.9722	.9190	.8459	.7496	.6293	1.2575
-94.05 C+O2	.8645	.7591	.6100	.4825	.3927	.3423	.3064	.2951	1.0484	1.1214	1.2177	1.3340	.7094
199.00 C2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
112.10 C2+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
54.19 C2+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
12.50 C2+H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
189.70 C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
242.30 C4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.1218	.0941	.0694	.0469	.0263	.0161	.0104	.0026	.0004	.0000	.0000	.0000	.1048
9.33 H+O	.2691	.1977	.1336	.0774	.0331	.0160	.0083	.0011	.0001	.0000	.0000	.0000	.2256
.00 H2	.3329	.3112	.2949	.2869	.2916	.3023	.3133	.3514	.4052	.4785	.5748	.6951	.3194
-57.80 H2+O	1.3924	1.4638	1.5246	1.5720	1.5997	1.6027	1.5982	1.5678	1.5156	1.4425	1.3462	1.2259	1.4363
59.56 O	.0554	.0344	.0186	.0077	.0019	.0006	.0002	.0000	.0000	.0000	.0000	.0000	.0422
.00 O2	.0913	.0644	.0386	.0172	.0043	.0012	.0004	.0000	.0000	.0000	.0000	.0000	.0752

SYSTEM LIQUID AIRPROPELLANT										PC 1000 PSIA				PC 500 PSIA				PC 250 PSIA				PC 125 PSIA																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
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PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 9C.2 O2 1.14 -3.08 75.
 RP-1 298 C#H1.953 0.80 -6.92 25.

BULK DENSITY = 1.031 GM/CC
 MIXTURE RATIO = 3.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 260.23 EU/100GMS

CHAMBER

THRUST

	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	560.2
PRESSURE, PSIA	3694.3	3148.2	2675.5	2266.2	1911.6	1727.5	1604.5	1338.5	1108.6	910.8	741.7	598.6	3341.7
TEMP, DEG K	19.59	44.85	66.35	84.59	100.01	107.84	112.99	123.85	132.88	140.33	146.42	151.37	35.95
ENTHALPY (-)	4.660	.4587	.4502	.4403	.4288	.4213	.4155	.4006	.3845	.3680	.3526	.3382	.4617
CP	148.24	201.68	237.78	264.50	277.07	285.04	301.16	313.93	324.09	332.17	338.58	344.76	119.30
IMPUL OPT	222.44	248.03	271.08	289.75	298.86	304.71	316.69	326.27	333.91	339.97	344.76	344.76	217.16
IMPUL VAC	1.067	1.674	3.021	5.754	8.485	11.258	22.328	44.562	89.078	177.780	353.602	1.000	
EPSILON													

	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	577.0
PRESSURE, PSIA	3694.3	3141.8	2675.5	2266.2	1911.6	1727.5	1604.5	1338.5	1108.6	910.8	741.7	598.6	3341.7
TEMP, DEG K	19.59	45.52	68.96	90.21	109.55	120.01	127.17	143.20	157.61	170.30	181.29	190.76	35.40
ENTHALPY (-)	4.041	3.943	3.851	3.767	3.691	3.651	3.625	3.573	3.544	3.536	3.535	3.535	3.981
X BAR	4.041	3.943	3.851	3.767	3.691	3.651	3.625	3.573	3.544	3.536	3.535	3.535	3.981
N	1.7108	1.7240	1.6500	1.5998	1.4380	1.3018	1.1830	.8389	.5502	.4537	.4320	.4253	1.7239
CP	150.17	207.23	247.86	279.74	295.56	305.93	327.91	346.51	362.09	375.06	385.88	396.61	117.27
IMPUL OPT	227.61	258.03	286.46	310.90	323.50	331.88	349.85	365.00	377.51	387.91	396.61	396.61	220.62
IMPUL VAC	1.086	1.790	3.416	6.926	10.615	14.492	30.769	65.143	136.457	285.461	599.083	1.000	
EPSILON													

	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	577.0
PRESSURE, PSIA	3694.3	3141.8	2675.5	2266.2	1911.6	1727.5	1604.5	1338.5	1108.6	910.8	741.7	598.6	3341.7
TEMP, DEG K	19.59	45.52	68.96	90.21	109.55	120.01	127.17	143.20	157.61	170.30	181.29	190.76	35.40
ENTHALPY (-)	4.041	3.943	3.851	3.767	3.691	3.651	3.625	3.573	3.544	3.536	3.535	3.535	3.981
X BAR	4.041	3.943	3.851	3.767	3.691	3.651	3.625	3.573	3.544	3.536	3.535	3.535	3.981
N	1.7108	1.7240	1.6500	1.5998	1.4380	1.3018	1.1830	.8389	.5502	.4537	.4320	.4253	1.7239
CP	150.17	207.23	247.86	279.74	295.56	305.93	327.91	346.51	362.09	375.06	385.88	396.61	117.27
IMPUL OPT	227.61	258.03	286.46	310.90	323.50	331.88	349.85	365.00	377.51	387.91	396.61	396.61	220.62
IMPUL VAC	1.086	1.790	3.416	6.926	10.615	14.492	30.769	65.143	136.457	285.461	599.083	1.000	
EPSILON													

COMPOSITION SHIFTING (MOL/100 GM)

170.89 C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
142.00 C#H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-2.90 C#H#C	.0004	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
67.00 C#H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-27.70 C#H2#O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
31.94 C#H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-17.89 C#H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-26.42 C#O	1.0294	.9420	.8539	.7671	.6839	.6386	.6082	.5469	.5088	.4836	.4522	.4081	.9773
-94.05 C#O2	.7587	.8463	.9345	1.0214	1.1045	1.1499	1.1802	1.2415	1.2797	1.3048	1.3363	1.3804	.8109
199.00 C2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
112.10 C2#H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
54.19 C2#H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
12.50 C2#H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
189.70 C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
242.30 C4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.1012	.0807	.0631	.0482	.0354	.0287	.0243	.0144	.0061	.0016	.0003	.0000	.0885
9.33 H#O	.3285	.2618	.2023	.1500	.1044	.0807	.0649	.0318	.0091	.0012	.0001	.0000	.2878
.00 H2	.2149	.1951	.1752	.1577	.1427	.1354	.1311	.1256	.1318	.1521	.1836	.2277	.2036
-57.80 H2#O	1.3145	1.3800	1.4384	1.4896	1.5339	1.5563	1.5707	1.5977	1.6070	1.5930	1.5627	1.5187	1.3545
59.56 O	.0861	.0621	.0427	.0275	.0159	.0107	.0076	.0024	.0003	.0000	.0000	.0000	.0712
.00 O2	.2057	.1745	.1406	.1053	.0702	.0508	.0378	.0128	.0015	.0000	.0000	.0000	.1874

SYSTEM LIQUID BIPROPELLANT										PC 1000, PSIA									
COMPONENT										DENSITY									
LOX										HEAT FORM									
RP-1										WT. 0/0									
298 C/HI-953										75.									
FROZEN EXPANSION										25.									
C STAR = 5620.7 FT/SEC																			
EPSILON	PC/F	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DEL VAC	DEL VAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC					
			DEG K	KCAL/100GM	GM DEG		/P	/P	LVL	10000	50000								
1.000	1.000	1000.000	3694.3	-19.59	1.466														
1.000	1.785	160.205	1941.7	-35.95	.462	119.3	97.9	.175	214.6	215.4	216.9	217.2	1.228	1.243					
2.000	9.002	111.087	2533.2	-72.75	.447	215.5	40.4	.364	250.6	252.2	255.4	256.0	1.435	1.465					
3.000	15.760	63.456	2270.2	-84.41	.440	237.5	33.4	.526	263.1	265.5	270.0	270.9	1.506	1.550					
4.000	26.441	40.915	2102.2	-91.77	.435	250.7	29.2	.715	269.4	272.6	278.7	279.9	1.542	1.602					
5.000	31.335	29.958	1982.8	-96.95	.431	259.5	26.7	.889	273.1	277.0	284.6	286.1	1.568	1.638					
6.000	42.255	23.666	1890.9	-100.90	.428	266.0	24.8	1.049	275.4	280.0	289.0	290.8	1.576	1.665					
7.000	52.442	19.669	1814.3	-104.08	.425	271.1	23.4	1.227	276.5	281.9	292.4	294.5	1.583	1.686					
8.000	62.854	15.900	1754.2	-106.71	.422	275.3	22.3	1.400	277.0	283.2	295.2	297.6	1.586	1.703					
9.000	73.618	13.347	1701.1	-108.95	.420	278.8	21.3	1.574		284.0	297.4	300.1	1.588	1.718					
10.000	85.272	11.727	1655.0	-110.88	.418	281.8	20.5	1.749		284.4	299.3	302.3	1.589	1.731					
11.000	96.963	10.313	1614.2	-112.50	.416	284.4	19.8	1.923		284.5	301.0	304.2	1.589	1.742					
12.000	109.253	9.153	1577.8	-114.09	.414	286.7	19.2	2.100			302.4	305.9	1.589	1.751					
13.000	122.053	8.190	1545.0	-115.45	.412	288.8	18.7	2.282			303.6	307.5	1.589	1.760					
14.000	135.322	7.391	1515.2	-116.62	.411	290.6	18.2	2.464			304.6	308.8	1.589	1.768					
15.000	148.009	6.720	1487.8	-117.60	.409	292.3	17.8	2.646			305.6	310.1	1.589	1.775					
16.000	162.544	6.152	1462.7	-118.43	.408	293.8	17.4	2.826			306.4	311.2	1.589	1.781					
17.000	176.442	5.688	1439.4	-119.18	.407	295.2	17.0	3.005			307.1	312.3	1.589	1.787					
18.000	190.444	5.251	1417.7	-119.85	.405	296.5	16.7	3.181			307.8	313.2	1.589	1.793					
19.000	204.459	4.890	1397.5	-120.48	.404	297.7	16.4	3.353			308.4	314.1	1.589	1.798					
20.000	218.545	4.575	1378.5	-121.24	.403	298.8	16.1	3.522			308.9	314.9	1.589	1.803					
21.000	232.609	4.299	1360.7	-122.04	.402	299.9	15.9	3.687			309.4	315.7	1.589	1.807					
22.000	246.611	4.055	1345.9	-122.84	.401	300.9	15.6	3.849			309.9	316.5	1.589	1.811					
23.000	261.456	3.818	1327.9	-123.64	.400	301.9	15.4	4.006			310.4	317.1	1.589	1.815					
24.000	276.061	3.596	1312.8	-124.48	.399	302.4	15.2	4.214			310.6	317.8	1.589	1.819					
25.000	290.484	3.396	1298.5	-125.45	.398	303.5	14.9	4.402			310.9	318.4	1.589	1.823					
26.000	311.135	3.214	1284.8	-125.99	.397	304.2	14.8	4.590			311.2	319.0	1.589	1.826					
27.000	327.966	3.040	1271.7	-126.51	.396	305.1	14.6	4.771			311.4	319.5	1.589	1.829					
28.000	345.007	2.898	1259.3	-127.00	.395	305.7	14.4	4.945			311.6	320.1	1.589	1.832					
29.000	362.171	2.761	1247.3	-127.47	.395	306.4	14.2	5.151			311.8	320.6	1.589	1.835					
30.000	379.450	2.635	1235.9	-127.93	.394	307.0	14.1	5.336			312.0	321.1	1.589	1.838					
31.000	396.816	2.520	1224.9	-128.36	.393	307.6	13.9	5.519			312.1	321.5	1.589	1.840					
32.000	414.246	2.414	1214.6	-128.77	.392	308.2	13.8	5.696			312.2	322.0	1.589	1.843					
33.000	431.715	2.316	1204.2	-129.17	.392	308.8	13.6	5.881			312.3	322.4	1.589	1.845					
34.000	449.200	2.226	1194.4	-129.55	.391	309.3	13.5	6.059			312.4	322.8	1.589	1.848					
35.000	466.642	2.143	1185.0	-129.92	.390	309.8	13.4	6.235			312.5	323.2	1.589	1.850					
36.000	484.142	2.066	1175.9	-130.28	.390	310.3	13.2	6.408			312.6	323.5	1.589	1.852					
37.000	501.583	1.994	1167.0	-130.62	.389	310.8	13.1	6.579			312.7	323.9	1.589	1.854					
38.000	518.932	1.927	1158.5	-130.95	.388	311.3	13.0	6.747			312.7	324.3	1.589	1.856					
39.000	536.236	1.865	1150.3	-131.27	.388	311.7	12.9	6.913			312.8	324.6	1.589	1.858					
40.000	553.466	1.807	1142.3	-131.58	.387	312.1	12.8	7.076			312.8	324.9	1.589	1.860					
41.000	570.613	1.753	1134.5	-131.89	.387	312.5	12.7	7.236			312.9	325.2	1.589	1.862					
42.000	587.672	1.702	1127.0	-132.17	.386	313.0	12.6	7.393			312.9	325.5	1.589	1.863					
43.000	604.640	1.654	1119.7	-132.45	.385	313.3	12.5	7.548			312.9	325.8	1.589	1.865					
44.000	621.516	1.609	1112.5	-132.73	.385	313.7	12.4	7.700			312.9	326.1	1.589	1.867					
45.000	638.337	1.563	1105.6	-132.99	.384	314.1	12.3	7.846			312.9	326.4	1.589	1.869					
46.000	655.082	1.518	1098.9	-133.25	.384	314.4	12.2	7.986			312.9	326.7	1.589	1.870					
47.000	671.754	1.471	1092.3	-133.50	.383	314.8	12.1	8.124			312.9	326.9	1.589	1.871					
48.000	688.355	1.429	1085.9	-133.75	.383	315.1	12.0	8.257			312.9	327.2	1.589	1.873					
49.000	704.846	1.388	1079.7	-133.99	.382	315.5	12.0	8.414			312.9	327.4	1.589	1.874					
50.000	721.049	1.349	1073.6	-134.22	.382	315.8	11.9	8.571			312.9	327.7	1.589	1.876					
8.485	68.046	14.696	1727.5	-107.84	.421	277.1	21.8	1.482	277.1	283.6	296.3	298.9	1.586	1.711					

SHIFTING EXPANSION														
C STAR = 5742.9 FT/SEC														
COMPONENT														
DENSITY														
LOX														
HEAT FORM														
RP-1														
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PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA PE 0.1 PSIA
 COMPONENT IREF FORMULA DENSITY HEAT FORM WT. O/C
 CEG K GM/CC (KCAL/FORM.WT.)
 LCX 90.2 02 1.14 -3.08 77.5
 RP-1 298 C#H1.953 0.80 -0.42 22.5

BULK DENSITY = 1.041 GM/CC
 MIXTURE RATIO = 3.444 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 252.28 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	560.7
TEMP, DEG K	3676.2	3138.2	2671.6	2267.0	1915.9	1733.5	1611.5	1387.6	1119.2	922.4	753.7	610.4	3329.4
ENTHALPY (-)	18.58	47.68	63.22	80.67	95.46	102.98	107.53	118.39	127.11	134.33	140.25	145.07	34.16
CP	.4511	.4440	.4358	.4264	.4156	.4085	.4031	.3891	.3740	.3583	.3434	.3290	.4470
IMPUL OPT	144.78	197.05	232.42	258.62	270.97	278.10	294.67	307.27	317.32	325.34	331.72	331.72	116.41
IMPUL VAC	217.31	242.42	265.05	283.41	297.38	298.15	309.98	319.46	327.05	333.69	337.87	337.87	212.11
EPSILON	1.067	1.677	3.031	5.782	8.534	11.332	22.521	45.056	90.315	180.401	360.757	1.000	
	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	577.4
TEMP, DEG K	3676.2	3400.9	3159.0	2943.7	2749.4	2643.8	2571.0	2404.4	2245.3	2088.5	1927.8	1753.8	3507.5
ENTHALPY (-)	18.58	43.32	65.71	86.05	104.62	114.70	121.63	137.23	151.55	164.70	176.72	187.63	33.64
X BAR	3.871	3.776	3.687	3.605	3.528	3.487	3.459	3.395	3.339	3.290	3.251	3.224	3.813
N	3.871	3.776	3.687	3.605	3.528	3.487	3.459	3.395	3.339	3.290	3.251	3.224	3.813
CP	1.7048	1.7416	1.7455	1.7156	1.6504	1.5949	1.5477	1.4064	1.2333	1.0310	.8146	.6063	1.7309
IMPUL OPT	146.70	202.48	242.27	273.59	289.17	299.41	321.27	340.11	356.53	370.91	383.49	383.49	114.45
IMPUL VAC	222.37	252.21	280.14	304.25	316.73	325.08	343.24	359.17	373.19	385.52	396.24	396.24	215.48
EPSILON	1.086	1.793	3.429	6.974	10.717	14.672	31.534	68.710	150.921	332.338	728.389	1.000	
	COMPOSITION SHIFTING (MOL/100 GM)												
170.89 C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
142.00 C#H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-2.90 C#H#C	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
67.00 C#H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-27.70 C#H2#O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
31.94 C#H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-17.85 C#H#H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-26.42 C#O	.7850	.6948	.6039	.5135	.4248	.3746	.3392	.2581	.1831	.1162	.0609	.0219	.7313
-94.05 C#O2	.8244	.9147	1.0057	1.0961	1.1848	1.2350	1.2704	1.3515	1.4265	1.4934	1.5487	1.5877	.8781
199.00 C2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
112.10 C2#H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
54.19 C2#H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
12.50 C2#H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
189.70 C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
242.30 C4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.0770	.0611	.0476	.0363	.0268	.0221	.0190	.0126	.0076	.0040	.0016	.0004	.0672
9.33 H#H	.3520	.2882	.2317	.1824	.1399	.1182	.1039	.0738	.0492	.0299	.0157	.0065	.3131
.00 H2	.1411	.1231	.1062	.0905	.0756	.0674	.0617	.0486	.0362	.0246	.0143	.0060	.1303
-57.80 H2#O	1.2160	1.2740	1.3259	1.3720	1.4127	1.4342	1.4486	1.4800	1.5072	1.5302	1.5489	1.5624	1.2513
59.56 O	.1080	.0821	.0609	.0439	.0305	.0241	.0202	.0124	.0069	.0033	.0013	.0003	.0920
.00 O2	.3669	.3376	.3050	.2699	.2331	.2113	.1956	.1583	.1222	.0887	.0598	.0346	.3498

SYSTEM LIQUID BIPHOPPELLANT										PC 1000, PSIA		PL 0.1 PSIA	
COMPONENT - TRUF FORMULA										DENSITY		HEAT FLOW	
TEMP °F										GP/CC		(KCAL/1000 BTU)	
LC4										1.14		-5.0P	
NP-1										1.14		-5.0P	
298 COM1955										C.CC		22.5	
FROZEN EXPANSION:										C STAR = 501.0 P/SEC		I SEA	
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C STAR = 501.0 P/SEC										I SEA		I SEA	
C STAR = 501.0 P/SEC										I SEA		I SEA	
C STAR = 501.0 P/SEC										I SEA		I SEA	
C STAR = 501.0 P/SEC										I SEA		I SEA	
C STAR = 501.0 P/SEC										I SEA		I SEA	
C STAR = 501.0 P/SEC										I SEA		I SEA	
C STAR = 501.0 P/SEC										I SEA		I SEA	
C STAR = 501.0 P/SEC										I SEA		I SEA	
C STAR = 501.0 P/SEC										I SEA		I SEA	
C STAR = 501.0 P/SEC										I SEA		I SEA	
C STAR = 501.0 P/SEC										I SEA		I SEA	
C STAR = 501.0 P/SEC										I SEA		I SEA	
C STAR = 501.0 P/SEC										I SEA		I SEA	
C STAR = 501.0 P/SEC										I SEA		I SEA	
C STAR = 501.0 P/SEC										I SEA		I SEA	
C STAR = 501.0 P/SEC										I SEA		I SEA	
C STAR = 501.0 P/SEC										I SEA		I SEA	
C STAR = 501.0 P/SEC										I SEA		I SEA	
C STAR = 501.0 P/SEC										I SEA		I SEA	
C STAR = 501.0 P/SEC										I SEA		I SEA	
C STAR = 501.0 P/SEC										I SEA		I SEA	
C STAR = 501.0 P/SEC										I SEA		I SEA	
C STAR = 501.0 P/SEC										I SEA		I SEA	
C STAR = 501.0 P/SEC										I SEA		I SEA	
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C STAR = 501.0 P/SEC										I SEA		I SEA	
C STAR = 501.0 P/SEC										I SEA		I SEA	
C STAR = 501.0 P/SEC										I SEA		I SEA	
C STAR = 501.0 P/SEC													

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 O2 1.14 -3.08 60.
 RP-1 298 C-H1.953 0.80 -6.92 4C.

BULK DENSITY = .974 GM/CC
 MIXTURE RATIO = 1.500 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 306.97 EU/100GMS

CHAMBER													THROAT
FROZEN EXPANSION													
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	165.1
TEMP, DEG K	2442.3	2025.8	1671.1	1369.5	1244.7	1113.8	898.7	719.4	571.7	451.8	356.0	278.8	2149.3
ENTHALPY (-)	25.58	47.40	65.45	80.29	86.27	92.41	102.24	110.13	116.43	121.42	125.34	128.47	40.99
CP	.5308	.5168	.5003	.4826	.4744	.4647	.4478	.4328	.4208	.4123	.4065	.4026	.5211
IMPUL OPT		137.78	186.25	218.18	229.78	241.13	258.24	271.22	281.13	288.76	294.60	299.18	115.79
IMPUL VAC		209.77	230.18	248.91	256.30	263.75	275.28	284.20	291.09	296.42	300.52	303.74	206.67
EPSILON		1.040	1.515	2.530	3.278	4.444	7.992	14.538	26.606	48.854	90.068	165.769	1.000
SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	165.8
TEMP, DEG K	2442.3	2041.8	1693.6	1400.2	1280.9	1158.4	976.4	887.3	839.7	797.1	758.3	722.4	2164.1
ENTHALPY (-)	25.58	47.48	65.70	80.78	86.89	93.24	103.60	112.49	120.60	128.08	135.02	141.47	40.93
X BAR	5.663	5.657	5.656	5.656	5.655	5.654	5.626	5.504	5.359	5.225	5.101	4.985	5.658
N	5.663	5.657	5.656	5.656	5.655	5.654	5.626	5.568	5.582	5.594	5.604	5.612	5.658
CP	.5750	.5335	.5166	.5125	.5153	.5273	.7919	4.7704	5.0959	5.2189	5.1606	4.9390	.5428
IMPUL OPT		138.03	186.83	219.14	230.96	242.62	260.53	274.98	287.51	298.62	308.56	317.53	115.56
IMPUL VAC		210.38	231.15	250.38	258.08	265.96	278.76	290.33	301.04	310.68	319.40	327.33	207.17
EPSILON		1.042	1.523	2.563	3.339	4.569	8.519	17.124	36.021	76.614	164.338	354.869	1.000
COMPOSITION SHIFTING (MOL/100 GM)													
170.89 C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
142.00 C+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-2.90 C+H+O	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
67.00 C+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-27.70 C+H2+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
31.94 C+H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-17.83 C+H4	.0000	.0000	.0000	.0001	.0002	.0007	.0148	.0437	.0369	.0310	.0261	.0221	.0000
-26.42 C+O	2.7004	2.6711	2.6242	2.5519	2.5072	2.4466	2.3009	2.0728	1.7868	1.5175	1.2651	1.0300	2.6819
-94.05 C+O2	.1608	.1904	.2373	.3095	.3541	.4142	.5458	.6802	.8151	.9445	1.0674	1.1824	.1794
199.00 C2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
112.10 C2+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
54.19 C2+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
12.50 C2+H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
189.70 C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
242.30 C4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.0146	.0025	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0047
9.33 H+O	.0010	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
.00 H2	2.0596	2.0949	2.1429	2.2151	2.2594	2.3177	2.4072	2.3903	2.3874	2.3887	2.3919	2.3948	2.0829
-57.80 H2+O	.7266	.6980	.6512	.5790	.5346	.4751	.3575	.3167	.3330	.3435	.3502	.3552	.7088
59.56 O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 C/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0648	.2227	.3685	.5029	.6270	.0000

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/G
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 02 1.14 -3.08 65.
 RP-1 298 C+H1.953 0.80 -6.92 35.

BULK DENSITY = .992 GM/CC
 MIXTURE RATIO = 1.857 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTRAPY 298.25 EU/100GMS

CHAMBER													THROAT
FROZEN EXPANSION													
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	166.9
TEMP, DEG K	3068.2	2587.9	2174.6	1818.7	1669.8	1512.3	1248.9	1023.5	831.8	670.5	536.4	426.5	2736.8
ENTHALPY (-)	23.58	48.09	68.72	86.02	93.09	100.45	112.41	122.25	130.28	136.78	142.00	146.17	40.55
CP	.5153	.5050	.4927	.4787	.4712	.4628	.4450	.4277	.4106	.3955	.3838	.3745	.5086
IMPUL OPT	146.01	198.15	233.06	245.90	258.59	277.98	292.97	304.66	313.81	320.97	326.57	328.23	121.48
IMPUL VAC	222.97	245.80	266.94	275.39	283.98	297.49	308.14	316.52	323.09	328.23	332.24	332.24	219.30
EPSILON	1.045	1.544	2.621	3.424	4.686	8.596	15.952	29.758	55.585	103.769	193.543	1.000	
SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	170.3
TEMP, DEG K	3068.2	2688.7	2314.2	1963.5	1813.4	1654.3	1391.7	1173.1	994.6	850.9	754.1	719.0	2821.1
ENTHALPY (-)	23.58	48.46	69.92	88.21	95.76	103.66	116.65	127.60	136.84	144.71	151.50	157.67	40.17
X BAR	5.023	4.978	4.957	4.950	4.949	4.949	4.949	4.949	4.949	4.946	4.901	4.789	4.990
N	5.023	4.978	4.957	4.950	4.949	4.949	4.949	4.949	4.949	4.946	4.905	4.912	4.990
CP	.8046	.6492	.5516	.5083	.4999	.4950	.4959	.5079	.5303	.5904	3.2582	4.9001	.6979
IMPUL OPT	147.10	200.78	237.12	250.58	263.94	284.55	300.81	313.90	324.62	333.59	341.54	341.54	120.13
IMPUL VAC	225.76	250.17	272.56	281.54	290.75	305.47	317.49	327.45	335.82	343.17	350.26	350.26	221.45
EPSILON	1.052	1.576	2.699	3.541	4.875	9.080	17.280	33.509	66.125	134.865	292.915	1.000	
COMPOSITION SHIFTING (MOL/100 GM)													
170.89 C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
142.00 C+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-2.90 C+H+O	.0005	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
67.00 C+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-27.70 C+H2+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
31.94 C+H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-17.89 C+H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	.0015	.0217	.0183	.0000
-26.42 C+O	2.1941	2.1701	2.1371	2.0872	2.0565	2.0145	1.9129	1.7778	1.6116	1.4260	1.2379	1.0083	2.1791
-94.05 C+O2	.3092	.3335	.3667	.4166	.4473	.4893	.5910	.7261	.8922	1.0763	1.2395	1.3536	.3244
199.00 C2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
112.10 C2+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
54.19 C2+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
12.50 C2+H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
189.70 C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
242.30 C4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.1034	.0454	.0136	.0026	.0010	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0628
9.33 H+O	.0390	.0120	.0022	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0191
.00 H2	1.1668	1.2035	1.2473	1.3017	1.3332	1.3754	1.4773	1.6124	1.7783	1.9581	2.0560	2.0615	1.1899
-57.80 H2+O	1.2068	1.2127	1.1897	1.1419	1.1113	1.0694	.9677	.8326	.6666	.4839	.3456	.3469	1.2140
59.56 O	.0020	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0006
.00 O2	.0009	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
.00 C/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0047	.1236	.0000

SYSTEM LIQUID BIPROPELLANT										PC 300, PSIA		HEAT FORM		WT. D/F	
COMPONENT										DENSITY		[KCAL/FORM.WT.]			
REF. FORMULA										G/CC		1.00		65.	
LGR										96.2 02		-1.08		35.	
RP-1										288 C=H1.953		0.80			
										FROZEN EXPANSION					
										C STAR = 5656.3 FT/SEC					
										CP CAL / I OPT DELVAC DELVAC		I SEA		I AT	
										GM DEG		LVL		10000	

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 02 1.14 -3.08 68.
 RP-1 298 C₈H₁₈ 0.80 -6.92 32.

BULK DENSITY = 1.004 GM/CC
 MIXTURE RATIO = 2.125 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 290.92 EU/100GMS

CHAMBER													THROAT
FROZEN EXPANSION													
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	167.6
TEMP, DEG K	3325.8	2825.2	2392.2	2017.6	1860.4	1693.4	1413.1	1170.9	962.7	785.0	634.8	509.6	2982.7
ENTHALPY (-)	22.39	47.30	68.44	86.30	93.65	101.34	113.92	124.38	133.02	140.10	145.84	150.47	39.51
CP	.5021	.4931	.4827	.4707	.4642	.4562	.4405	.4232	.4060	.3900	.3753	.3638	.4960
IMPUL OPT	147.22	200.16	235.81	248.99	262.08	282.18	297.88	310.24	320.00	327.72	333.81	333.81	122.05
IMPUL VAC	225.13	248.68	270.54	279.32	288.31	302.51	313.84	322.84	329.96	335.59	340.01	340.01	221.26
EPSILON		1.047	1.556	2.659	3.487	4.794	8.868	16.614	31.304	59.066	111.323	209.373	1.000
SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	172.5
TEMP, DEG K	3325.8	3008.9	2686.1	2352.3	2196.9	2024.3	1725.2	1466.1	1247.0	1065.3	916.2	794.0	3124.1
ENTHALPY (-)	22.39	47.88	70.49	90.31	98.64	107.44	122.09	134.54	145.13	154.15	161.88	168.55	38.95
X BAR	4.696	4.619	4.566	4.538	4.531	4.527	4.525	4.525	4.525	4.525	4.525	4.524	4.645
N	4.696	4.619	4.566	4.538	4.531	4.527	4.525	4.525	4.525	4.525	4.525	4.524	4.645
CP	1.1667	.9283	.7121	.5704	.5319	.5049	.4831	.4804	.4883	.5066	.5324	.5629	1.0158
IMPUL OPT	148.93	204.57	243.09	257.55	272.02	294.51	312.37	326.77	338.57	348.36	356.59	356.59	120.03
IMPUL VAC	229.61	256.40	281.05	290.97	301.15	317.43	330.72	341.70	350.88	358.64	365.30	365.30	224.54
EPSILON		1.059	1.624	2.840	3.753	5.200	9.765	18.674	36.239	71.313	142.271	287.463	1.000
COMPOSITION SHIFTING (MOL/100 GM)													
170.89 C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
142.00 C ₂ H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-2.90 C ₂ H ₂ O	.0005	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
67.00 C ₂ H ₂	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-27.70 C ₂ H ₂ O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
31.94 C ₂ H ₂	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-17.89 C ₂ H ₂	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-26.42 C ₂ O	1.8499	1.8152	1.7839	1.7492	1.7269	1.7013	1.6329	1.5393	1.4172	1.2655	1.0903	.9034	1.8273
-94.05 C ₂ O ₂	.4388	.4738	.5053	.5400	.5603	.5879	.6563	.7499	.8720	1.0237	1.1989	1.3856	.4616
199.00 C ₂	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
112.10 C ₂ H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
54.19 C ₂ H ₂	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
12.50 C ₂ H ₂	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
189.70 C ₃	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
242.30 C ₄	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.1597	.1024	.0531	.0196	.0107	.0047	.0007	.0001	.0000	.0000	.0000	.0000	.1227
9.33 H ₂ O	.1278	.0674	.0259	.0062	.0026	.0008	.0001	.0000	.0000	.0000	.0000	.0000	.0876
.00 H ₂	.7367	.7447	.7490	.8081	.8309	.8606	.9306	1.0245	1.1467	1.2983	1.4735	1.6597	.7400
-57.80 H ₂ O	1.3547	1.4057	1.4269	1.4144	1.3979	1.3721	1.3044	1.2109	1.0888	.9371	.7619	.5754	1.3902
59.56 O	.0160	.0055	.0011	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0085
.00 O ₂	.0117	.0042	.0008	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0064

SYSTEM LIQUID BIPROPELLANT										PC 300. PSIA		HEAT FORM		WT. 0/0	
COMPONENT THERM FORMULA										DENSITY		KCAL/FORM.WT.			
LOX										90.2 82		1.14		-1.08	
RP-1										298 CHTL.953		0.80		-6.92	
										C STAR = 5713.7 FT/SEC					
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/G	1 OPT	DELVAC	DELVAC	1 SEA	1 AT	1 AT	1 VAC	CF SEA	CF VAC	
			DEG K	1000G	CM DEG		/P	/P	10000	10000	10000	10000	10000	10000	
1.000	1.000	300.000	3325.8	-22.39	.502										
1.000	1.750	167.605	3295.8	-22.39	.502										
1.000	9.250	32.412	3197.3	-77.80	.477	122.0	99.2	.592	212.6	215.2	220.3	221.3	1.197	1.246	
3.000	16.371	18.325	1945.5	-89.48	.460	242.0	32.6	1.780	248.4	256.3	271.6	276.4	1.399	1.546	
4.000	25.027	11.607	1786.2	-97.08	.461	254.9	28.6	2.373		256.0	270.3	283.4		1.596	
5.000	34.517	8.181	1645.7	-102.29	.455	267.8	24.9	2.958			268.3	281.9		1.695	
6.000	45.155	6.464	1585.2	-106.25	.451	270.1	23.8	3.584			280.8	293.9		1.695	
7.000	56.317	5.327	1515.0	-109.40	.447	275.1	22.3	4.194			287.3	297.5		1.675	
8.000	67.059	4.434	1456.7	-111.99	.443	279.7	21.2	4.775			292.2	300.4		1.691	
9.000	79.159	3.749	1400.0	-114.19	.440	283.2	19.9	5.332			296.7	303.7		1.704	
10.000	92.340	3.249	1353.6	-116.09	.437	285.5	19.4	5.966			298.7	304.9		1.717	
11.000	106.052	2.830	1325.4	-117.75	.435	288.0	18.7	6.598			295.5	306.7		1.727	
12.000	119.977	2.500	1291.4	-119.23	.432	290.3	18.1	7.220			296.0	308.3		1.736	
13.000	134.113	2.237	1260.8	-120.55	.430	292.2	17.5	7.827			296.4	309.7		1.744	
14.000	148.242	2.023	1231.0	-121.78	.428	293.9	17.0	8.413			296.7	311.0		1.751	
15.000	162.368	1.847	1207.7	-122.82	.426	295.6	16.6	8.974			296.9	312.2		1.758	
16.000	176.372	1.701	1184.3	-123.81	.424	297.0	16.2	9.515			313.2			1.764	
17.000	191.162	1.570	1162.8	-124.73	.423	298.4	15.8	10.035			314.2			1.769	
18.000	207.464	1.466	1142.7	-125.57	.421	299.7	15.5	10.545			315.1			1.774	
19.000	224.228	1.338	1124.0	-126.36	.420	300.8	15.2	11.138			315.9			1.779	
20.000	241.279	1.243	1106.4	-127.10	.418	301.8	14.9	11.767			316.7			1.783	
21.000	258.563	1.180	1090.0	-127.78	.417	302.8	14.6	12.327			317.4			1.787	
22.000	276.086	1.087	1074.5	-128.43	.416	303.6	14.3	12.816			318.1			1.791	
23.000	293.740	1.021	1059.8	-129.04	.414	304.6	14.1	13.293			318.7			1.795	
24.000	311.458	.963	1046.0	-129.61	.413	305.4	13.9	14.433			319.3			1.798	
25.000	329.319	.911	1032.8	-130.15	.412	306.2	13.7	15.029			319.9			1.801	
26.000	347.116	.860	1019.4	-130.67	.410	307.0	13.5	15.616			320.5			1.804	
27.000	365.008	.822	1008.4	-131.18	.410	307.8	13.3	16.199			321.1			1.807	
28.000	382.820	.784	997.0	-131.63	.409	308.3	13.1	16.752			321.4			1.810	
29.000	400.583	.749	986.1	-132.07	.408	308.9	13.0	17.303			321.9			1.812	
30.000	418.286	.717	975.7	-132.50	.407	309.3	12.8	17.843			322.3			1.815	
31.000	435.923	.687	965.7	-132.90	.406	309.7	12.6	18.376			322.6			1.818	
32.000	453.359	.659	956.1	-133.29	.405	310.6	12.5	18.967			323.1			1.819	
33.000	475.835	.630	946.8	-133.67	.405	311.1	12.4	19.594			323.5			1.822	
34.000	498.512	.606	937.9	-134.03	.404	311.6	12.2	20.223			323.9			1.824	
35.000	517.544	.584	929.4	-134.37	.404	311.9	12.1	20.849			324.3			1.826	
36.000	538.750	.557	921.1	-134.71	.402	312.6	12.0	21.480			324.8			1.828	
37.000	560.156	.536	913.1	-135.03	.402	313.0	11.8	22.106			324.9			1.829	
38.000	581.747	.516	905.4	-135.34	.401	313.5	11.7	22.734			325.2			1.831	
39.000	603.507	.496	897.8	-135.66	.400	313.9	11.6	23.358			325.5			1.833	
40.000	625.417	.480	890.7	-135.93	.400	314.3	11.5	23.981			325.8			1.835	
41.000	647.461	.463	883.6	-136.21	.399	314.7	11.4	24.600			326.1			1.836	
42.000	669.640	.448	876.8	-136.48	.398	315.0	11.3	25.216			326.3			1.838	
43.000	691.880	.436	870.2	-136.76	.398	315.3	11.2	25.829			326.6			1.839	
44.000	714.225	.424	863.8	-137.00	.397	315.6	11.1	26.438			326.8			1.841	
45.000	736.639	.407	857.6	-137.24	.397	316.1	11.0	27.041			327.1			1.842	
46.000	759.109	.395	851.5	-137.48	.396	316.4	10.9	27.640			327.4			1.843	
47.000	781.622	.384	845.7	-137.72	.396	316.8	10.8	28.234			327.6			1.845	
48.000	804.168	.374	840.1	-137.96	.395	317.1	10.8	28.824			327.8			1.846	
49.000	826.729	.363	834.3	-138.18	.395	317.4	10.7	29.407			328.0			1.847	
50.000	849.302	.353	828.9	-138.38	.394	317.7	10.6	29.985			328.3			1.848	
3.487	20.414	14.496	1800.4	-53.65	.466	249.0	30.3	2.064	249.0	258.1	275.8	279.3	1.402	1.573	
SHIFTING EXPANSION															
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/G	1 OPT	DELVAC	DELVAC	1 SEA	1 AT	1 AT	1 VAC	CF SEA	CF VAC	
			DEG K	1000G	CM DEG		/P	/P	10000	10000	10000	10000	10000	10000	
1.000	1.000	300.000	3325.8	-22.39	1.147										
1.000	1.739	172.481	3124.1	-76.95	1.161	120.0	104.4	.606	215.6	218.3	223.5	224.5	1.235	1.286	
2.000	8.350	35.750	3155.3	-78.76	.845	221.0	44.7	1.251	248.3	253.8	268.9	268.6	1.386	1.522	
3.000	16.370	18.325	1945.5	-89.48	.581	242.0	32.6	1.822	248.4	260.0	275.9	275.1	1.410	1.550	
4.000	22.356	13.395	2162.3	-100.43	.525	260.6	32.5	2.426		248.2	280.9	293.1		1.612	
5.000	30.744	9.750	2044.5	-106.43	.507	274.0	29.4	3.033			288.0	300.0		1.650	
6.000	39.882	7.522	1952.4	-111.03	.497	277.7	27.5	3.656			294.0	305.2		1.679	
7.000	49.684	6.498	1884.8	-115.07	.487	281.4	25.8	4.280			300.0	310.8		1.699	
8.000	59.712	5.624	1814.9	-118.76	.476	284.1	24.6	4.903			304.3	312.7		1.720	
9.000	69.881	4.998	1761.4	-122.35	.464	287.9	23.6	5.490			308.2	315.5		1.740	
10.000	80.110	4.374	1714.9	-125.59	.453	290.7	22.7	6.099			307.4	318.0		1.759	
11.000	91.170	3.741	1670.1	-128.43	.442	293.6	22.0	6.726			306.5	320.0		1.778	
12.000	103.757	3.291	1631.7	-130.31	.430	296.3	21.3	7.366			305.4	322.0		1.771	
13.000	115.954	2.987	1601.1	-132.08	.420	300.0	20.7	8.007			310.0	323.7		1.781	
14.000	128.240	2.339	1575.5	-134.30	.409	303.0	20.2	8.635			310.5	325.2		1.789	
15.000	140.190	2.195	1550.6	-136.04	.400	305.0	19.7	9.264			310.8	326.8		1.794	
16.000	152.822	1.963	1523.6	-137.79	.393	307.5	19.3	9.838			311.0	327.8		1.800	
17.000	164.946	1.819	1500.7	-139.28	.385	310.0	18.9	10.408			311.2	329.0		1.804	
18.000	176.913	1.646	1476.5	-140.59	.377	311.5	18.6	10.956			310.4			1.810	
19.000	189.387	1.584	1459.8	-141.83	.370	311.8	18.4	11.525			310.6			1.816	
20.000	203.372	1.475	1441.4	-143.35	.363	313.0	18.0	12.170			310.2			1.824	
21.000	217.553	1.379	1424.1	-145.06	.356	315.2	17.7	12.810			313.8			1.831	
22.000	232.015	1.293	1407.8	-147.35	.350	316.2	17.4	13.465			313.7			1.836	
23.000	246.601	1.217	1392.5	-149.09	.343	317.3	17.2	14.110			313.4			1.840	
24.000	261.317	1.149	1378.0	-150.78	.336	318.7	16.9	14.784			313.2			1.845	
25.000	276.118	1.086	1364.3	-152.44	.330	319.1	16.7	15.451			313.0			1.848	
26.000	290.984	1.031	1351.3	-154.07	.324	320.0	16.5	16.018			313.5			1.851	
27.000	305.881	.981	1338.9	-155.67	.318	320.8	16.3	16.662			313.7			1.855	
28.000	320.781	.931	1327.1	-157.24	.312	321.4	16.1	17.294			313.8			1.857	
29.000	335.681	.884	1315.8	-158.79	.307	322.3	16.0	17.904			313.9			1.861	
30.000	350.458	.846	1305.1	-160.31	.301	323.0	15.8	18.461			313.8			1.864	
31.000	365.275	.821	1294.8	-161.81	.297	323.7	15.6	19.048			313.3			1.867	
32.000	379.927	.795	1284.9	-163.29	.293	324.3	15.5	19.678			313.0			1.869	
33.000	394.552	.768	1275.4	-164.75	.289	324.9	15.4	20.192			313.0			1.872	
34.000	409.114	.733	1266.3	-166.19	.285	325.5	15.2	20.748			310.7			1.875	

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 02 1.14 -3.08 70.
 RP-1 298 C-H1.953 0.80 -6.92 30.

BULK DENSITY = 1.011 GM/CC
 MIXTURE RATIO = 2.333 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 285.39 EU/100GMS

	CHAMBER										THROAT	
	FROZEN EXPANSION											
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050
TEMP, DEG K	3429.7	2923.2	2484.4	2103.7	1943.6	1773.5	1487.1	1238.9	1024.5	840.4	683.7	551.8
ENTHALPY (-)	21.59	46.30	67.32	85.16	92.52	100.24	112.91	123.51	132.31	139.55	145.47	150.28
CP	.4917	.4834	.4741	.4629	.4568	.4497	.4349	.4184	.4019	.3854	.3701	.3576
IMPUL OPT	146.61	199.46	235.17	248.41	261.57	281.87	297.77	310.35	320.35	328.29	334.59	341.23
IMPUL VAC	224.30	247.99	270.02	278.90	287.99	302.42	313.98	323.22	330.57	336.41	341.02	344.36
EPSILON	1.048	1.562	2.678	3.517	4.845	8.998	16.936	32.071	60.833	115.268	217.843	1.000
	SHIFTING EXPANSION											
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050
TEMP, DEG K	3429.7	3151.3	2880.3	2599.1	2460.7	2298.1	1993.0	1710.3	1462.8	1251.9	1075.1	928.7
ENTHALPY (-)	21.59	46.96	69.77	90.20	98.94	108.28	124.04	137.61	149.22	159.15	167.66	174.99
X BAR	4.507	4.415	4.339	4.285	4.269	4.256	4.245	4.242	4.242	4.242	4.242	4.447
N	4.507	4.415	4.339	4.285	4.269	4.256	4.245	4.242	4.242	4.242	4.242	4.447
CP	1.4978	1.2842	1.0105	.7467	.6522	.5730	.4968	.4723	.4687	.4751	.4904	.5131
IMPUL OPT	148.55	204.74	244.32	259.41	274.63	298.54	317.69	333.21	345.93	356.48	365.31	371.92
IMPUL VAC	229.52	257.52	283.73	294.41	305.41	323.04	337.44	349.31	359.20	367.54	374.63	379.10
EPSILON	1.064	1.655	2.949	3.933	5.499	10.443	20.088	39.097	76.921	153.005	307.845	1.000
	COMPOSITION SHIFTING (MOL/100 GM)											
170.89 C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
142.00 C+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-2.90 C+H+O	.0004	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
67.00 C+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-27.70 C+H2+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
31.94 C+H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-17.09 C+H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-26.42 C+O	1.6152	1.5631	1.5170	1.4789	1.4625	1.4432	1.3977	1.3339	1.2475	1.1358	.9976	.8375
-94.05 C+O2	.5305	.5828	.6290	.6672	.6836	.7029	.7485	.8122	.8986	1.0103	1.1485	1.3087
199.00 C2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
112.10 C2+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
54.19 C2+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
12.50 C2+H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
189.70 C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
242.30 C4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.1710	.1266	.0849	.0470	.0321	.0187	.0049	.0008	.0001	.0000	.0000	.1424
9.33 H+O	.2057	.1368	.0771	.0322	.0184	.0084	.0012	.0001	.0000	.0000	.0000	.1611
.00 H2	.5306	.5182	.5175	.5327	.5459	.5652	.6135	.6787	.7654	.8772	1.0154	1.1755
-57.80 H2+O	1.3766	1.4457	1.4971	1.5234	1.5246	1.5170	1.4792	1.4165	1.3303	1.2185	1.0803	.9202
59.56 O	.0380	.0196	.0076	.0018	.0007	.0002	.0000	.0000	.0000	.0000	.0000	.0256
.00 O2	.0391	.0219	.0090	.0021	.0008	.0002	.0000	.0000	.0000	.0000	.0000	.0279

SYSTEM LIQUID DIAPYRELLANT													PC 300.0	PSIA	DENSITY		HEAT FORM	WT. G/S
CONCENTR TREF FORMULA													DEG K	GM/CC	(KCAL/FORM.WT.)			
LOX													90.2 02	1.14	-3.08		70.	
RP-1													298 COM1.993	0.80	-8.92		30.	
													C STAR = 9040.3 FT/SEC					
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/I	DPT	DELVAC	DELVAC	I SEA	I AT	I VAC	CF SEA	CF VAC					
			DEG K	KCAL/1000G	GM DEG		/P	/P	LVL	10000	SC000	LVL	LVL					
1.000	1.000	300.000	211.59	-211.59	1.478													
1.000	1.785	168.049	308.33	-78.34	1.487	212.0	99.1	.590	211.7	214.3	219.4	1.194	1.245					
2.000	9.171	32.712	2290.2	-76.48	1.449	219.0	40.1	1.226	241.1	246.5	257.0	1.361	1.446					
3.000	18.184	18.537	2034.9	-88.34	1.460	241.0	32.9	1.774	247.8	255.7	270.8	1.400	1.548					
4.000	24.687	12.152	1873.1	-95.76	1.456	250.0	28.7	2.364		258.4	270.7		1.548					
5.000	33.900	8.418	1767.1	-102.95	1.453	258.0	25.0	3.000			281.8		1.758					
6.000	44.379	6.760	1668.7	-104.92	1.445	269.3	24.1	3.570			287.3		1.658					
7.000	55.104	5.425	1597.2	-104.09	1.441	274.3	22.7	4.179			289.9		1.678					
8.000	66.418	4.517	1537.7	-110.71	1.438	278.4	21.5	4.762			291.8		1.695					
9.000	77.460	3.874	1487.0	-114.94	1.432	281.9	20.8	5.358			293.4		1.749					
10.000	90.310	3.122	1442.8	-114.84	1.432	284.8	19.7	5.940			294.4		1.721					
11.000	103.622	2.494	1403.8	-116.51	1.430	287.4	19.0	6.571			295.2		1.741					
12.000	117.210	2.560	1369.1	-118.00	1.428	288.4	18.4	7.193			295.8		1.761					
13.000	130.988	2.290	1337.8	-119.34	1.425	291.6	17.9	7.801			296.2		1.780					
14.000	144.810	2.012	1309.7	-120.55	1.423	294.0	17.4	8.398			296.5		1.799					
15.000	158.581	1.892	1283.9	-121.44	1.422	295.6	16.9	8.958			296.7		1.763					
16.000	172.324	1.762	1259.6	-122.64	1.420	296.5	16.6	9.502			296.8		1.769					
17.000	185.886	1.614	1237.5	-123.57	1.418	297.9	16.2	10.031			314.0		1.775					
18.000	201.702	1.487	1216.9	-124.97	1.417	299.1	15.9	10.548			315.0		1.780					
19.000	217.871	1.377	1197.7	-125.23	1.415	300.3	15.5	11.064			315.8		1.784					
20.000	234.343	1.280	1179.8	-125.97	1.414	301.3	15.3	11.514			316.6		1.784					
21.000	251.048	1.195	1162.9	-126.67	1.413	302.4	15.0	12.000			317.3		1.793					
22.000	267.995	1.127	1147.0	-127.33	1.412	303.3	14.7	12.510			317.9		1.797					
23.000	285.079	1.062	1131.9	-127.96	1.411	304.2	14.5	12.958			318.7		1.801					
24.000	302.275	.992	1117.7	-128.53	1.409	305.0	14.3	13.438			319.3		1.804					
25.000	319.543	.939	1104.2	-129.08	1.408	305.8	14.1	13.942			319.9		1.807					
26.000	336.847	.891	1091.3	-129.61	1.407	306.6	13.9	15.571			320.4		1.811					
27.000	354.150	.848	1078.0	-130.09	1.406	307.4	13.7	16.235			320.9		1.815					
28.000	371.444	.808	1067.1	-130.58	1.405	307.9	13.5	16.719			321.4		1.816					
29.000	388.691	.772	1056.1	-131.03	1.405	308.6	13.3	17.276			321.9		1.819					
30.000	405.881	.739	1045.4	-131.47	1.404	309.2	13.2	17.822			322.3		1.821					
31.000	423.007	.709	1035.0	-131.89	1.403	310.0	13.0	18.350			322.8		1.824					
32.000	440.043	.682	1025.2	-132.28	1.402	310.3	12.9	18.862			323.2		1.826					
33.000	459.504	.653	1015.7	-132.66	1.401	310.9	12.7	19.499			323.6		1.828					
34.000	479.102	.626	1006.5	-133.03	1.400	311.4	12.6	20.125			324.0		1.831					
35.000	499.147	.600	997.6	-133.39	1.399	311.9	12.5	20.740			324.4		1.834					
36.000	519.800	.577	989.1	-133.72	1.399	312.3	12.4	21.377			324.7		1.835					
37.000	540.324	.555	980.8	-134.05	1.398	312.8	12.2	22.004			325.0		1.836					
38.000	561.034	.535	972.9	-134.37	1.397	313.2	12.1	22.629			325.3		1.838					
39.000	581.913	.516	965.1	-134.68	1.397	313.7	12.0	23.257			325.6		1.840					
40.000	602.947	.497	957.6	-134.98	1.396	314.1	11.9	23.875			325.9		1.841					
41.000	624.111	.481	950.4	-135.26	1.395	314.5	11.8	24.495			326.2		1.843					
42.000	645.358	.465	943.4	-135.54	1.395	314.9	11.7	25.113			326.5		1.845					
43.000	666.761	.450	936.6	-135.81	1.394	315.2	11.6	25.727			326.8		1.847					
44.000	688.279	.436	929.9	-136.07	1.394	315.6	11.5	26.335			327.1		1.848					
45.000	709.834	.423	923.5	-136.32	1.393	315.9	11.4	26.944			327.3		1.850					
46.000	731.457	.410	917.2	-136.57	1.393	316.3	11.3	27.547			327.6		1.851					
47.000	753.131	.398	911.1	-136.81	1.392	316.6	11.2	28.146			327.8		1.852					
48.000	774.863	.387	905.2	-137.04	1.391	316.9	11.1	28.741			328.1		1.853					
49.000	796.583	.377	899.4	-137.27	1.391	317.2	11.0	29.328			328.3		1.855					
50.000	818.341	.367	893.7	-137.49	1.390	317.5	11.0	29.912			328.5		1.856					
3.517	20.414	16.496	1963.2	-92.52	1.457	246.4	30.5	2.074	248.4	257.6	275.4	1.404	1.576					
SHIFTING EXPANSION																		
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/I	DPT	DELVAC	DELVAC	I SEA	I AT	I VAC	CF SEA	CF VAC					
			DEG K	KCAL/1000G	GM DEG		/P	/P	LVL	10000	SC000	LVL	LVL					
1.000	1.000	300.000	3429.7	-211.59	1.478													
1.000	1.738	172.650	3251.2	-78.01	1.371	115.5	104.6	.606	215.2	217.9	223.1	1.233	1.186					
2.000	8.041	37.311	2783.1	-77.29	1.313	222.6	46.6	1.748	248.8	254.3	265.0	1.369	1.470					
3.000	13.942	21.517	2434.7	-86.55	1.340	251.5	37.0	2.811	257.7	265.7	281.3	1.418	1.585					
4.000	20.910	14.347	2245.6	-95.66	1.367	280.2	34.8	4.243	270.1	290.0	295.0		1.624					
5.000	28.933	10.514	2134.2	-105.72	1.392	275.5	31.9	5.304	271.3	287.3	302.4		1.664					
6.000	38.461	8.176	2235.8	-110.58	1.558	278.3	29.8	6.645		301.8	308.1		1.695					
7.000	49.535	6.588	2181.5	-115.53	1.535	282.5	28.2	8.217		305.2	311.9		1.726					
8.000	62.170	5.471	2117.8	-117.74	1.518	285.9	26.8	9.900		307.9	314.2		1.740					
9.000	64.031	4.685	2062.1	-120.62	1.508	293.5	25.8	5.503		309.9	319.3		1.757					
10.000	73.350	3.690	2013.0	-123.06	1.500	297.1	24.9	6.079		311.4	322.0		1.772					
11.000	83.325	3.000	1969.3	-125.71	1.493	300.2	24.1	6.684		312.9	324.1		1.787					
12.000	94.022	2.516	1927.2	-127.52	1.486	303.0	23.4	7.319		314.6	325.7		1.800					
13.000	105.154	2.152	1887.6	-128.84	1.484	305.5	22.7	7.975		316.4	328.2		1.816					
14.000	116.439	2.576	1802.1	-130.41	1.481	307.7	22.2	8.613		318.2	329.9		1.805					
15.000	127.740	2.248	1872.3	-131.86	1.479	309.7	21.7	9.239		319.6	331.4		1.824					
16.000	139.424	2.195	1844.7	-133.04	1.478	311.6	21.2	9.857		321.4	333.0		1.836					
17.000	150.479	1.994	1772.1	-134.36	1.475	313.2	20.8	10.466		316.2	334.1		1.858					
18.000	161.734	1.855	1755.2	-135.49	1.474	314.6	20.4	11.023		316.4	335.2		1.895					
19.000	172.883	1.735	1733.0	-136.56	1.473	316.2	20.1	11.581		316.6	336.3		1.901					
20.000	183.910	1.631	1712.0	-137.52	1.472	317.4	19.8	12.121			336.5		1.917					
21.000	194.549	1.526	1692.5	-138.44	1.471	318.8	19.5	12.754			336.3		1.862					
22.000	209.547	1.432	1674.1	-139.31	1.470	320.0	19.2	13.399			339.2		1.867					
23.000	222.738	1.347	1656.7	-140.13	1.471	321.1	18.9	14.045			341.4		1.871					
24.000	236.087	1.271	1640.7	-140.91	1.471	322.2	18.7	14.680			343.5		1.876					
25.000	249.568	1.201	1625.8	-141.65	1.471	323.2	18.6	15.332			345.6		1.880					
26.000	263.154	1.140	1609.7	-142.34	1.471	324.1	18.2	15.972			347.3		1.884					
27.000	276.818	1.084	1595.9	-143.01	1.471	325.0	18.0	16.607			349.0		1.888					
28.000	290.534	1.031	1581.9	-143.65	1.471	325.9	17.8	17.236			350.7		1.892					
29.000	304.289	1.000	1568.4	-144.26	1.471	326.8	17.6	17.861			352.4		1.896					
30.000	318.046	.943	1556.4	-144.84	1.471	327.5	17.4	18.475			354.9		1.895					
31.000	331.756	.904	1544.5	-145.40	1.471	328.2	17.3	19.083			356.4		1.901					
32.000	345.524	.868	1533.1	-145.93	1.471	328.9	17.1	19.683			358.0		1.904					
33.000	359.210	.835	1522.0	-146.45	1.471	329.6	16.9	20.287			359.5		1.907					
34.000	372.847	.805	1511.4	-146.95	1.471	330.2	16.8	20.856			361.0		1.910					
35.000	386.420	.776	1501.2	-147.42	1.471	330.9	16.6	21.429			362.5		1.912					
36.000	399.925	.750	1491.3	-147.88	1.471	331.5	16.5	21.993			364.0		1.915					

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300, PSIA
 COMPONENT REF FORMULA DENSITY HEAT FLOW WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 LEX 90.2 02 1.14 -3.08 12.5
 RP-1 298 C-H1.953 0.80 -6.92 27.5

BULK DENSITY = 1.021 GM/CC
 MIXTURE RATIO = 2.636 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTRUPY 277.93 EU/100GMS

CHAMBER	THROAT												
FROZEN EXPANSION													
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	5.873	1.623	.680	.285	.119	.050	167.3
TEMP, DEG K	3495.1	2988.2	2547.9	2165.2	2003.9	1832.3	1545.0	1291.6	1073.6	885.6	724.6	588.0	3146.9
ENTHALPY (-)	20.59	44.64	65.17	82.64	89.88	97.47	109.98	120.49	129.26	136.52	142.49	147.55	37.15
CP	.4780	.4703	.4617	.4512	.4459	.4392	.4254	.4100	.3942	.3780	.3630	.3495	.4722
IMPUL OPT		144.64	196.93	232.34	245.51	258.61	278.87	294.41	307.47	317.98	325.65	332.08	120.00
IMPUL VAC		221.41	245.00	266.97	275.84	284.94	299.43	311.07	320.45	327.94	333.92	338.66	217.45
EPSILON		1.049	1.568	2.695	3.544	4.890	9.115	17.226	32.769	62.463	118.954	225.961	1.000
SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	5.873	1.623	.680	.285	.119	.050	173.4
TEMP, DEG K	3495.1	3244.2	3015.4	2799.3	2699.3	2582.9	2347.2	2081.8	1811.4	1563.6	1346.9	1161.2	3354.0
ENTHALPY (-)	20.59	45.33	67.79	88.23	97.14	106.82	123.63	138.59	151.68	161.01	172.78	181.19	36.46
X BAR	4.298	4.199	4.108	4.029	3.996	3.961	3.918	3.896	3.890	3.889	3.888	3.888	4.234
N	4.298	4.199	4.108	4.029	3.996	3.961	3.918	3.896	3.890	3.889	3.888	3.888	4.234
CP	1.8449	1.7644	1.6038	1.3508	1.2023	1.0200	.7037	.5271	.4679	.4525	.4505	.4572	1.8027
IMPUL OPT		146.70	202.64	242.57	258.05	273.90	299.59	320.40	337.70	351.99	363.86	373.78	117.48
IMPUL VAC		226.97	255.49	282.77	294.19	306.71	325.94	342.24	355.74	365.93	374.40	381.23	221.37
EPSILON		1.066	1.675	3.041	4.165	5.835	11.445	22.515	44.291	87.516	174.036	348.670	1.000
COMPOSITION SHIFTING (MOL/100 GM)													
170.89 C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
142.00 C+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-2.90 C+H+O	.0003	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
67.00 C+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-27.70 C+H2+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
51.94 C+H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-17.89 C+H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-26.42 C+O	1.5330	1.2614	1.1910	1.1250	1.0971	1.0682	1.0247	.9901	.9441	.8900	.8127	.7136	1.2879
-94.05 C+O2	.6319	.7058	.7762	.8422	.8702	.8991	.9424	.9772	1.0192	1.0773	1.1546	1.2537	.6792
199.00 C2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
112.10 C2+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
54.19 C2+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
12.50 C2+H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
189.70 C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
242.30 C4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.1586	.1269	.0987	.0750	.0615	.0487	.0261	.0095	.0022	.0003	.0000	.0000	1.382
9.33 H+O	.2901	.2238	.1642	.1087	.0854	.0609	.0242	.0054	.0006	.0000	.0000	.0000	.2476
.00 H2	.3537	.3513	.3129	.3003	.2970	.2962	.3058	.3324	.3755	.4342	.5117	.6108	.3392
-57.80 H2+O	1.3429	1.4144	1.4772	1.5300	1.5506	1.5701	1.5911	1.5809	1.5441	1.4867	1.4094	1.3103	1.3884
59.56 O	.0741	.0499	.0306	.0161	.0109	.0063	.0014	.0001	.0000	.0000	.0000	.0000	.0582
.00 O2	.1115	.0851	.0584	.0335	.0234	.0158	.0030	.0002	.0000	.0000	.0000	.0000	.0950

SYSTEM LIQUID NITROGEN										PC SCO. PSIA									
COMPONENT										DENSITY									
REF. FORMULA										HEAT FLOW									
LEG. R										KCAL/HR/IN. L									
200.000										1.00									
200.000										-0.02									
PROF. EXPANSION										0									
C. STAN. 5021.000										1.000									
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PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. G/G
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 02 1.14 -3.08 75.
 RP-1 298 C₁₀H_{1.953} 0.80 -6.92 25.

BULK DENSITY = 1.031 GM/CC
 MIXTURE RATIO = 3.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 269.98 EU/100GMS

	CHAMBER										THROAT												
	FROZEN EXPANSION																						
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	167.2										
TEMP, DEG K	3511.4	3008.7	2571.2	2190.3	2029.6	1858.5	1569.5	1318.1	1099.6	910.6	748.1	609.7	3166.1										
ENTHALPY (-)	19.59	42.72	62.51	79.39	86.40	93.76	105.91	116.15	124.72	131.85	137.73	142.54	35.52										
CP	.4635	.4563	.4481	.4382	.4332	.4269	.4141	.3997	.3846	.3690	.3545	.3407	.4587										
IMPUL OPT		141.85	193.22	228.08	241.08	254.00	274.03	289.83	302.42	312.50	320.58	327.04	117.71										
IMPUL VAC		217.22	240.51	262.21	276.99	280.00	294.38	305.99	315.34	322.85	328.87	333.67	213.29										
EPSILON		1.049	1.571	2.706	3.562	4.921	9.195	17.426	33.253	63.606	121.583	231.839	1.000										

	SHIFTING EXPANSION																						
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	173.1										
TEMP, DEG K	3511.4	3272.4	3055.6	2867.3	2783.2	2690.7	2524.6	2361.9	2189.5	1983.3	1746.2	1518.9	3357.1										
ENTHALPY (-)	19.59	43.39	65.08	84.93	93.64	103.16	119.93	135.36	149.51	162.37	173.78	183.75	34.87										
X BAR	4.110	4.011	3.919	3.834	3.797	3.756	3.685	3.622	3.573	3.545	3.536	3.535	4.047										
N	4.110	4.011	3.919	3.834	3.797	3.756	3.685	3.622	3.573	3.545	3.536	3.535	4.047										
CP	1.9993	2.0156	1.9511	1.9180	1.8637	1.7841	1.5762	1.2728	.8827	.5599	.4533	.4313	2.0142										
IMPUL OPT		143.88	198.93	238.42	253.80	269.62	295.44	317.34	336.19	352.43	366.25	377.90	115.26										
IMPUL VAC		222.76	251.04	278.28	289.79	302.02	322.66	340.65	356.31	369.68	380.83	390.19	217.17										
EPSILON		1.066	1.481	3.069	4.160	5.954	11.938	24.398	50.262	102.830	207.447	417.268	1.000										

	COMPOSITION SHIFTING (MOL/100 GM)															
170.89 C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
142.00 C ₂ H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-2.90 C ₂ H ₂ O	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
67.00 C ₂ H ₂	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-27.70 C ₂ H ₂ O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
31.94 C ₂ H ₂	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-17.89 C ₂ H ₂	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-26.42 C ₂ O	1.0716	.9898	.9699	.8240	.7859	.7430	.6657	.5953	.5376	.5006	.4750	.4424	1.0202			
-94.05 C ₂ O ₂	.7167	.7986	.8815	.9644	1.0026	1.0454	1.1228	1.1932	1.2509	1.2878	1.3134	1.3459	.7681			
199.00 C ₂	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000			
112.10 C ₂ H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000			
54.19 C ₂ H ₂	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000			
12.50 C ₂ H ₄	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000			
189.70 C ₃	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000			
242.30 C ₄	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000			
52.10 H	.1319	.1078	.0871	.0692	.0617	.0537	.0401	.0279	.0169	.0073	.0019	.0003	.1163			
9.33 H ₂ O	.3431	.2807	.2246	.1747	.1535	.1306	.0919	.0580	.0289	.0084	.0011	.0001	.3030			
.00 H ₂	.2375	.2158	.1959	.1779	.1700	.1617	.1478	.1372	.1323	.1392	.1605	.1931	.2236			
-57.80 H ₂ O	1.2714	1.3363	1.3947	1.4466	1.4888	1.4926	1.5326	1.5663	1.5912	1.5994	1.5844	1.5531	1.3131			
59.56 O	.1084	.0813	.0591	.0412	.0341	.0269	.0158	.0077	.0025	.0003	.0000	.0000	.0907			
.00 O ₂	.2298	.2011	.1695	.1361	.1201	.1018	.0680	.0369	.0128	.0016	.0000	.0000	.2121			

SYSTEM LIQUID BIPROPELLANT										PC 300. PSIA		HEAT FORM		WT. 8/0		
COMPONENT										DENSITY		(KCAL/POUN.WT.)				
REF. FORMULA										GM/CC						
DEG K										1.14		-3.08		75.		
LOR										10.2 82		1.14		75.		
RP-1										250 CONL.953		0.80		-6.92		
										FROZEN EXPANSION						
										C STAR = 5516.4 FT/SEC						
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	DEG K	OPT DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC		
			DEG K	KCAL/1000G	GM DEG			/P	LVL	10000	50000	LVL	LVL	LVL		
1.000	1.000	100.000	3511.4	-19.59	444	117.7	95.6	.972	204.9	207.4	212.3	215.3	1.195	1.244		
2.000	1.794	107.239	3164.1	-35.52	444	211.8	19.4	1.187	233.7	239.0	249.1	251.2	1.363	1.465		
3.000	9.047	33.162	2382.8	-70.92	444	233.2	32.4	1.719	240.4	248.0	262.7	265.6	1.402	1.549		
4.000	24.153	12.400	1986.1	-89.14	431	246.0	28.4	2.290								
5.000	33.210	9.633	1850.5	-94.10	427	261.0	24.0	3.457								
6.000	43.283	6.336	1761.4	-97.88	423	266.0	24.0	3.457								
7.000	53.848	5.371	1689.5	-100.91	420	266.0	22.6	4.049								
8.000	64.631	4.632	1627.7	-103.41	417	270.0	21.4	4.618								
9.000	75.378	3.880	1578.7	-105.53	415	273.4	20.5	5.057								
10.000	87.405	3.432	1534.2	-107.37	412	276.3	19.7	5.747								
11.000	100.170	2.995	1494.9	-108.99	410	278.9	19.0	6.358								
12.000	113.232	2.649	1459.9	-110.42	408	281.1	18.4	6.954								
13.000	126.515	2.371	1428.4	-111.70	406	283.1	17.9	7.558								
14.000	139.841	2.145	1399.7	-112.87	405	284.9	17.5	8.136								
15.000	153.132	1.959	1373.5	-113.93	403	286.5	17.0	8.694								
16.000	166.321	1.804	1349.4	-114.90	402	287.9	16.6	9.231								
17.000	179.510	1.673	1327.1	-115.78	400	289.3	16.3	9.746								
18.000	193.547	1.550	1306.3	-116.62	399	290.5	16.0	10.307								
19.000	208.403	1.436	1286.9	-117.40	398	291.7	15.7	10.916								
20.000	224.553	1.336	1268.7	-118.12	397	292.8	15.4	11.524								
21.000	240.553	1.248	1251.5	-118.80	395	294.8	15.1	12.132								
22.000	256.518	1.169	1235.4	-119.43	394	295.7	14.9	12.738								
23.000	272.425	1.100	1220.2	-120.03	393	296.4	14.7	13.336								
24.000	289.212	1.037	1205.7	-120.60	392	296.4	14.4	13.930								
25.000	305.883	.981	1192.0	-121.14	391	297.2	14.2	14.517								
26.000	322.422	.931	1178.9	-121.65	390	298.0	14.0	15.094								
27.000	338.739	.886	1166.4	-122.14	390	298.4	13.9	15.666								
28.000	355.268	.844	1154.3	-122.60	389	298.4	13.7	16.227								
29.000	371.766	.807	1143.1	-123.04	388	300.0	13.5	16.777								
30.000	388.216	.773	1132.2	-123.44	387	300.6	13.4	17.314								
31.000	404.605	.741	1121.7	-123.81	386	301.2	13.2	17.848								
32.000	420.926	.711	1111.7	-124.16	386	301.8	13.1	18.367								
33.000	437.174	.686	1102.0	-124.43	385	302.3	13.0	18.877								
34.000	453.220	.659	1092.6	-124.99	384	302.8	12.8	19.366								
35.000	469.064	.633	1083.6	-125.34	383	303.3	12.7	20.062								
36.000	483.159	.608	1074.9	-125.67	383	303.8	12.6	20.694								
37.000	512.429	.585	1066.5	-125.99	382	304.2	12.5	21.275								
38.000	531.880	.564	1058.3	-126.30	381	304.7	12.3	21.802								
39.000	551.457	.544	1050.5	-126.60	381	305.1	12.2	22.488								
40.000	571.266	.525	1042.9	-126.87	380	305.5	12.1	23.093								
41.000	591.172	.507	1035.4	-127.17	380	305.9	12.0	23.637								
42.000	611.202	.491	1028.2	-127.45	379	306.3	11.9	24.299								
43.000	631.343	.475	1021.3	-127.71	378	306.7	11.8	24.899								
44.000	651.580	.460	1014.5	-127.97	378	307.1	11.7	25.496								
45.000	671.900	.446	1007.9	-128.22	377	307.4	11.6	26.089								
46.000	692.293	.433	1001.5	-128.44	377	307.7	11.6	26.681								
47.000	712.744	.421	995.2	-128.69	376	308.1	11.5	27.269								
48.000	733.244	.409	989.1	-128.94	376	308.4	11.4	27.853								
49.000	753.781	.398	983.2	-129.14	375	308.7	11.3	28.432								
50.000	774.346	.387	977.4	-129.36	375	309.0	11.2	28.999								
5.562	20.414	14.496	2029.6	-86.40	.433	241.1	29.9	2.036	241.1	250.1	267.5	271.0	1.406	1.581		

SHIFTING EXPANSION														
C STAR = 5682.7 FT/SEC														
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	DEG K	OPT DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC
			DEG K	DEG K	DEG K	DEG K	DEG K	DEG K	LVL	10000	50000	LVL	LVL	LVL
1.000	1.000	300.000	3511.4	-34.87	2.014	115.3	101.9	.589	208.5	211.1	216.2	217.2	1.230	1.181
1.000	1.733	173.102	3357.1	-71.54	1.975	213.0	46.8	1.211	242.0	247.4	257.8	259.8	1.370	1.471
2.000	7.759	38.471	2996.0	-84.28	1.922	237.3	40.1	1.776	251.3	259.1	274.4	277.4	1.423	1.570
3.000	15.276	22.597	2879.6	-92.55	1.871	251.9	36.4	2.358	251.7	264.2	286.4	288.4	1.437	1.633
4.000	19.413	15.453	2773.7	-98.41	1.825	262.2	34.0	2.950	265.9					
5.000	26.022	11.537	2735.0	-103.36	1.782	269.9	32.3	3.533						
6.000	32.785	9.151	2688.8	-107.25	1.742	278.2	31.0	4.147						
7.000	40.116	7.478	2650.7	-110.53	1.705	281.3	30.0	4.741						
8.000	47.480	6.192	2618.4	-113.36	1.670	285.6	29.1	5.344						
9.000	55.337	5.421	2590.4	-115.85	1.637	289.4	28.4	5.954						
10.000	62.975	4.744	2565.7	-118.04	1.605	292.7	27.7	6.519						
11.000	70.515	4.254	2543.5	-120.04	1.574	295.6	27.2	7.067						
12.000	77.993	3.847	2523.4	-121.65	1.543	298.4	26.7	7.600						
13.000	86.478	3.479	2504.9	-123.15	1.514	301.1	26.2	8.122						
14.000	95.121	3.154	2488.1	-125.03	1.489	302.9	25.8	8.649						
15.000	103.889	2.880	2472.5	-126.45	1.462	304.4	25.5	9.171						
16.000	112.675	2.643	2457.8	-127.78	1.437	306.0	25.1	9.691						
17.000	121.552	2.429	2444.1	-129.11	1.411	307.4	24.8	10.185						
18.000	130.511	2.230	2431.1	-130.34	1.387	308.8	24.6	10.670						
19.000	139.680	2.157	2418.8	-131.41	1.369	310.1	24.4	11.144						
20.000	147.778	2.030	2407.2	-132.22	1.346	311.6	24.3	11.604						
21.000	156.396	1.918	2396.1	-132.25	1.344	312.1	24.0	12.054						
22.000	164.902	1.813	2385.5	-132.22	1.342	312.6	23.8	12.504						
23.000	173.308	1.731	2375.4	-132.14	1.301	315.7	23.6	13.030						
24.000	181.667	1.652	2365.4	-132.02	1.281	316.4	23.4	13.557						
25.000	190.460	1.573	2356.4	-132.00	1.260	318.0	23.2	14.078						
26.000	200.340	1.497	2347.4	-132.46	1.240	319.1	23.0	14.593						
27.000	210.101	1.426	2338.4	-132.42	1.220	320.0	22.8	15.106						
28.000	219.952	1.364	2330.5	-132.16	1.200	321.2	22.7	15.610						
29.000	229.882	1.305	2322.5	-132.06	1.182	322.1	22.5	16.125						
30.000	239.827	1.251	2314.5	-132.54	1.163	323.5	22.3	16.639						
31.000	249.820	1.200	2307.0	-132.49	1.146	324.7	22.2	17.148						
32.000	259.883	1.154	2299.4	-132.82	1.128	324.8	22.0	17.658						
33.000	269.933	1.111	2292.4	-132.43	1.111	325.0	21.9	18.175						
34.000	280.040	1.071	2285.4	-132.02	1.095	326.1	21.8	18.690						
35.000	290.115	1.034	2278.6	-132.59	1.079	327.1	21.6	19.207						
36.000	300.280	0.999	2272.9	-132.49	1.064	328.0	21.5	19.718						
37.000	310.319	0.967	2266.4	-132.67	1.049	328.6	21.4	20.224						
38.000	320.354	0.936	2259.0	-132.46	1.034	329.2	21.3	20.739						
39.000	330.430	0.908	2252.7	-132.49	1.020	329.9	21.2	21.250						
40.000	340.484	0.884	2246.4	-132.18	1.006	330.5	21.1	21.754						
41.000	350.484	0.856	2240.5	-132.66	0.992	331.0	21.0	22.249						
42.000	360.493	0.832	2234.4	-132.12	0.979	331.8	20.9	22.749						
43.000	370.385	0.810	2228.8	-132.67	0.967	332.4	20.8	23.250						
44.000	380.279	0.789	2223.2	-132.46	0.954	332.9	20.7	23.750						
45.000	390.125	0.769	2217.6	-132.18	0.943	333.4	20.6	24.257						
46.000	399.942	0.750	2212.0	-132.47	0.930	334.0	20.5	24.768						
47.000	409.709	0.732	2206.6	-132.55	0.918	334.4	20.4	25.273						
48.000	419.432	0.715	2201.3	-132.45	0.907	335.1	20.3	25.783						
49.000	429.101	0.699	2196.1	-132.18	0.896	335.6	20.2	26.293						
50.000	438.750	0.684	2190.9	-132.62	0.885	336.1	20.1	26.804						
4.180	20.149	1.690	2783.2	-93.44	1.844	253.9	36.0	2.444	253.8	264.6	285.6	289.8	1.437	1.441

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 .DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 02 1.14 -3.08 77.5
 RP-1 298 C+H1.953 0.80 -6.92 22.5

BULK DENSITY = 1.041 GM/CC
 MIXTURE RATIO = 3.444 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 261.62 EU/100GMS

	CHAMBER										THROAT															
	FROZEN EXPANSION										SHIFTING EXPANSION															
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	5.873	1.623	.680	.285	.119	.050	167.6													
TEMP, DEG K	3494.2	2998.8	2566.9	2190.4	2031.3	1861.9	1575.5	1326.1	1109.0	921.0	759.0	620.5	3155.3													
ENTHALPY (-)	18.60	40.66	59.56	75.72	82.43	89.49	101.16	111.02	119.29	126.18	131.88	136.56	33.73													
CP	.4486	.4415	.4336	.4242	.4195	.4136	.4015	.3880	.3737	.3599	.3449	.3313	.4439													
IMPUL OPT	138.54	188.78	222.92	235.65	248.34	268.01	283.55	295.96	305.93	313.93	320.35	326.95	208.33													
IMPUL VAC	212.21	235.06	256.36	268.99	273.85	288.01	299.47	308.72	316.17	322.16	326.95	328.33														
EPSILON	1.050	1.574	2.714	3.575	4.943	9.251	17.565	33.593	64.418	123.475	236.112	1.000														

	CHAMBER										THROAT															
	FROZEN EXPANSION										SHIFTING EXPANSION															
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	5.873	1.623	.680	.285	.119	.050	174.4													
TEMP, DEG K	3494.2	2998.8	2566.9	2190.4	2031.3	1861.9	1575.5	1326.1	1109.0	921.0	759.0	620.5	3155.3													
ENTHALPY (-)	18.60	41.29	62.01	81.00	89.33	98.46	114.58	129.48	143.27	156.06	167.49	178.81	32.99													
X BAR	3.937	3.842	3.754	3.671	3.634	3.594	3.523	3.457	3.398	3.344	3.297	3.257	3.477													
N	3.937	3.842	3.754	3.671	3.634	3.594	3.523	3.457	3.398	3.344	3.297	3.257	3.477													
CP	1.9795	2.0161	2.0236	1.9994	1.9756	1.9496	1.8462	1.7152	1.5524	1.3550	1.1340	.8973	2.0056													
IMPUL OPT	140.52	194.34	232.99	248.07	263.59	288.97	310.54	329.34	345.81	360.38	373.33	384.96														
IMPUL VAC	217.60	245.32	272.05	283.36	295.40	315.76	335.66	349.49	363.59	376.16	387.35	397.10														
EPSILON	1.068	1.686	3.082	4.181	5.990	12.046	24.755	51.620	108.692	230.201	488.276	1.000														

COMPOSITION SHIFTING (MOL/100 GP)

170.89 C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
142.00 C+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-2.90 C+H+O	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
67.00 C+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-27.70 C+H2+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
31.94 C+H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-17.89 C+H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-26.42 C+O	.8529	.7487	.6636	.5784	.5388	.4942	.4119	.3524	.2569	.1865	.1229	.0687	.7806
-94.05 C+O2	.7766	.8608	.9460	1.0312	1.0708	1.1154	1.1977	1.2772	1.3527	1.4231	1.4867	1.5409	.8289
199.00 C2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
112.10 C2+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
54.19 C2+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
12.50 C2+H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
189.70 C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
242.30 C4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.1015	.0826	.0665	.0527	.0470	.0409	.0308	.0223	.0153	.0096	.0053	.0023	.0894
9.33 H+O	.3635	.3036	.2500	.2027	.1826	.1612	.1254	.0946	.0686	.0470	.0296	.0164	.3253
.00 H2	.1586	.1406	.1237	.1078	.1007	.0928	.0785	.0650	.0520	.0397	.0260	.0172	.1473
-57.80 H2+O	1.1806	1.2380	1.2898	1.3363	1.3563	1.3779	1.4151	1.4483	1.4778	1.5038	1.5264	1.5452	1.2171
59.56 O	.1324	.1036	.0796	.0600	.0521	.0440	.0311	.0211	.0134	.0078	.0040	.0016	.1138
.00 O2	.3905	.3641	.3344	.3070	.2862	.2678	.2324	.1965	.1609	.1262	.0937	.0650	.3745

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